Mobility Alternatives Finance Study
Final Report

December 6, 2006

INTERNATIONAL

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Introduction

The Mobility Alternative Finance Study

The Mobility Alternative Finance Study is tasked with answering questions about the Phase 2 Toll Plan

- Questions about possible alternatives to the Toll Plan
  - What alternative finance and traffic management approaches are available?
  - What approaches are being taken by other metro areas in Texas and elsewhere?
- Questions about the Toll Plan's finances
  - What project funds would be available both with and without the Toll Plan?
  - Will the Toll Plan cover its costs?
  - Will it generate surplus revenue?
- Questions about the impacts of the Toll Plan and alternatives
  - What are their impacts on congestion?
  - What are their costs and benefits to drivers?
  - What are their costs and benefits to Central Texas residents?
  - What are their costs and benefits to the Central Texas economy?

Each of these general questions has specific sub-questions

Some of the questions involve general background information, and some involve detailed analysis of the Toll Plan and alternatives

Outline of the report

This draft final report summarizes the answers that we have found to the questions that were asked in our Scope of Work

The report covers

- Part 1: Background information
- Part 2: Analysis of the Phase 2 Toll Plan and alternatives
- Part 3: Summary & Conclusions

Part 1: Background Information

National and State Transportation Funding Situation

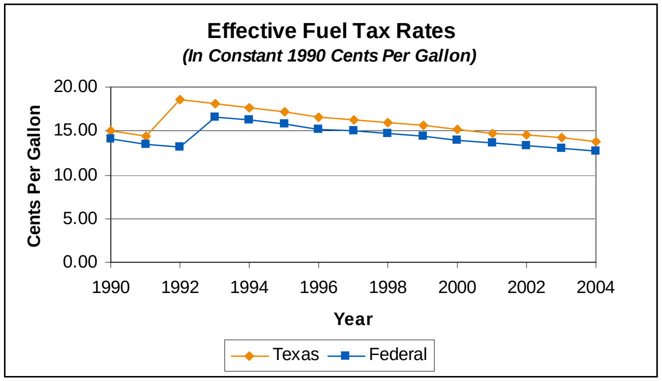
National backdrop: Highway funding issues

The nation is approaching a highway system funding crisis

- The traditional main source of money for major highway projects is the Highway Trust Fund, which is funded in large part from fuel taxes
- The effective rate of the fuel tax is decreasing because it is not indexed to inflation
- Improvements in vehicle fuel consumption rates are likely to continue and further decrease the yield of this funding source
- Vehicle travel and related fuel consumption is increasing
- But the combined effect is a leveling off of fuel tax proceeds at the Federal and state level
- At the same time, the costs of constructing and maintaining the highway system are increasing
- This has led to constraints on funds available for highway projects and contributed to a slowdown of highway capacity expansion
- The Appendix has details on these issues

National backdrop: Highway funding issues

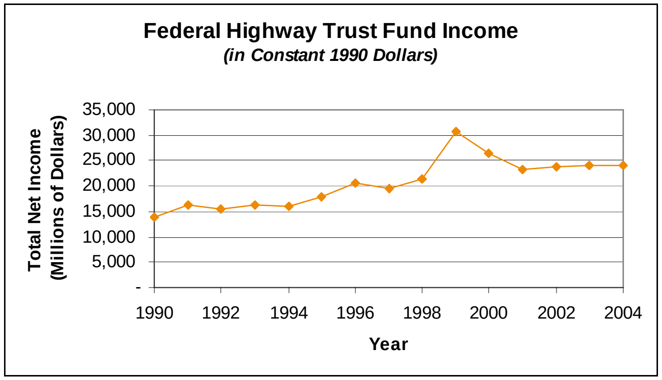
The rate of the main transportation funding source, the fuel tax, has been effectively decreasing when adjusted for inflation



Source: FHWA

National backdrop: Highway funding issues

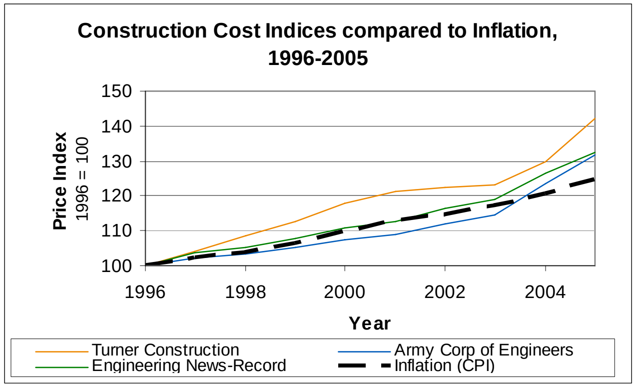
Combining the decreasing effective fuel tax rate with increasing fuel efficiency and increasing travel, the inflation-adjusted receipts of the Federal Highway Trust Fund are only slowly growing



Source: FHWA

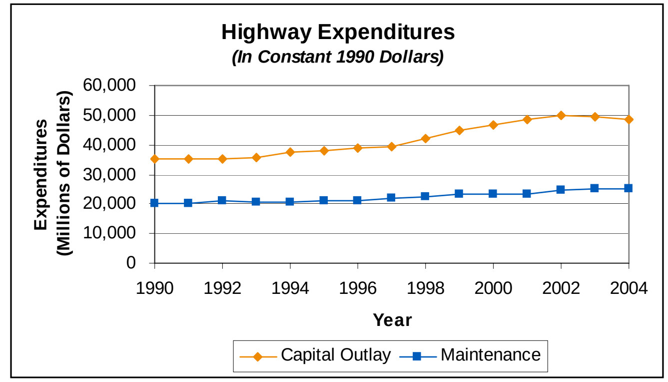
National backdrop: Highway funding issues

Further amplifying the problem, highway construction costs are rising faster than general inflation



National backdrop: Highway funding issues

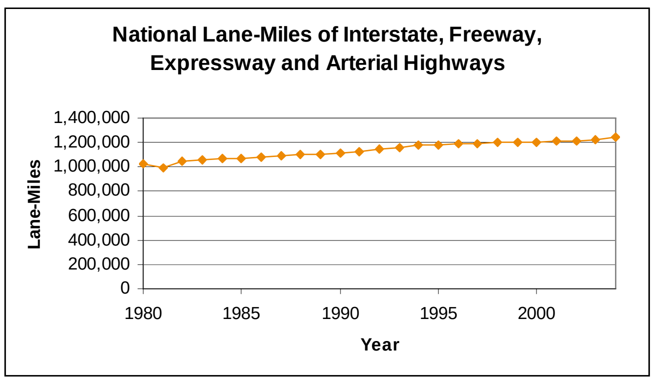
The cost of expanding and maintaining the highway network is increasing



Source: FHWA

National backdrop: Highway congestion issues

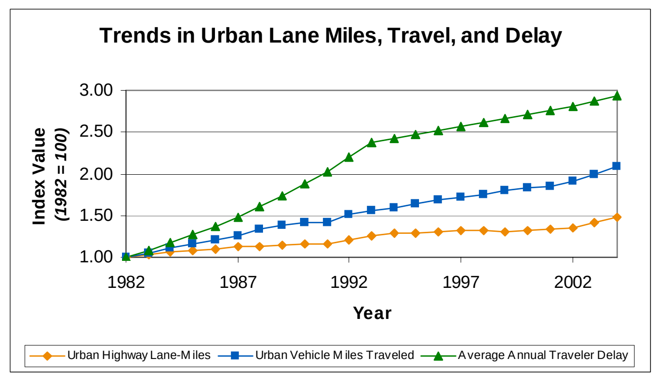
Funding issues have contributed to slow growth of national highway capacity



Source: FHWA

National backdrop: Highway congestion issues

The slow growth of highway capacity and the increase in travel has led to a large increase in travel delays, particularly around urban areas



Source: FHWA; Texas Transportation Institute

National backdrop: Highway funding issues

Comparing projected Trust Fund revenues against highway funding obligations in the 2005 national surface transportation legislation, serious analysts (Congressional Budget Office) have warned that the highway account of the Trust Fund may be empty by 2010

Texas backdrop

Highway funding is also facing a crisis in Texas

- Texas MPOs have identified $136 billion in priority highway projects over the next 25 years
  - Funding is only available for $68 billion; $68 billion is unfunded
- Other Texas urban areas have identified $10.5 billion in priority highway projects over the next 25 years
  - Funding is only available for $1.5 billion; $9 billion is unfunded
- Texas state planners have identified $13.7 billion in priority highway projects on the Texas Trunk and Interstate Systems over the next 25 years
  - Funding is only available for $4.7 billion; $9 billion is unfunded
- Combined, the Texas highway system is facing a funding gap of $86 billion over the next 25 years

Source: Texas Department of Transportation

Possible Responses to the Situation

Central issues

The central issue is how to provide effective mobility options to people and businesses in an efficient, fair and sustainable way

Let's not forget some of the basic causes and the need to address them:

- Urban sprawl → better land use planning and management
- Auto dependency → better non-automobile options: transit, non-motorized modes
- Demand peaking → flex-time, tele-commuting, etc.

For roads the central issue boils down to a few questions:

- How do we pay for them? – the funding issue
- How do we reduce traffic congestion? – the congestion management issue
- How do we do these things efficiently, fairly, sustainably?

The seriousness of this issue around the world has led to many ideas about possible approaches, and to increasing implementation of these ideas

Tolling is one such approach, with many variations

How well does tolling address the central issues?

It generates revenue, often a lot of revenue

- Even in toll systems that were implemented for other reasons (congestion management, environmental concerns)

When drivers pay to use a road, they think about their travel options

- Travel on a different route? At a different time? Carpool? Transit?
- Congestion management effects depend on toll levels and system design
  - Some systems emphasize traffic reduction, others providing mobility options

The fairness question is complex

- Money is collected from toll road users (“the user pays”) but:
- How is the revenue used?
  - General revenue? Transportation system improvements? Toll roads only?
- Are non-users affected?
  - Other roads congested by drivers avoiding toll
- Does tolling discriminate against those least able to pay?
  - Higher income users are less sensitive to toll
  - Mid- & lower-income users value and use premium option when they need it
  - Toll revenue can be applied to address fairness issues
  - Other financing options (fuel tax, sales tax) are also regressive

Alternatives to tolling for generating highway revenue

Raise Federal or local fuel taxes

- Not a politically popular move, especially with current prices
- Current Federal fuel tax is about 18¢/gallon, hasn’t changed since 1993
- Texas local fuel taxes are 20¢/gallon,haven’t changed since 1992 Average local fuel tax across states in US is about 19¢/gallon
- Addresses congestion somewhat

Raise local sales, property or other taxes

- Not a politically popular move
- Doesn’t address congestion
- Fairness issues
  - Not tied to road use
  - Regressive

Development impact fees

- Typical fee levels only raise revenue to cover local road improvements, not general needs
- To the user the fee is a fixed cost, not directly tied to road use

Example toll roads and systems

The Appendix contains descriptions of a number of example toll roads and systems including:

- Pocahantas Parkway (Richmond VA)
- SR 91 Express Lanes (Orange County CA)
- IH 10 Katy Freeway QuickRide (Houston TX)
- Indiana East-West Toll Road
- Chicago Skyway
- I-81 Corridor (VA)
- I-15 FastTrak (San Diego CA)
- SR 125 South Bay Expressway (San Diego CA)
- Florida Turnpike Enterprise
- Foothill/Eastern and San Joaquin Hill Transportation Corridor Agency (CA)

It also includes a glossary of toll-related terms

Toll Rate Benchmarks

While the Phase 2 toll rates have not yet been set, national figures are available for comparison

- The toll rates for Phase 2 Toll Plan will not be set until the investment grade traffic and revenue studies to support toll revenue bond issuance are prepared
  - The sketch level traffic and revenue study uses a toll rate of $0.15 / mile in 2010 dollars ($0.13 / mile in 2006 dollars); this is a representative toll rate applied for planning purposes
- Nationally, the average toll rate is $0.14/ mile
  - California SR 91 Express Lanes have the highest rate of $ 0.78 / mile for the top peak period
  - The William H Natcher Parkway and the Audubon Parkway in Kentucky use the lowest toll rate of $0.02 / mile
- When considering only those facilities opened within the last 15 years, the average toll rate increases to $0.32
  - This reflects the higher construction, right-of-way acquisition, environmental and maintenance costs prevalent today
  - It also reflects the increasingly common use of tolls for congestion management

Response of Texas to the Situation

The Texas Transportation Commission's Minute Order

- House Bill 3588 (June 2003) authorized tolling and innovative financing measures as means to develop the Texas transportation system
- In December 2003, the Texas Transportation Commission issued Minute Order 109519
  - Controlled access mobility projects in any phase of development or construction must be evaluated for tolling, including
    - New construction
    - Capacity addition projects
  - Review and evaluation of projects for tolling should be done in accordance with applicable rules and regulations
    - Including those governing conversion of non-tolled to tolled facilities
  - Net revenue generated by toll projects (revenue not needed for debt service or O&M costs) should remain in the project's local area so other transportation facilities may be constructed

Responses to the Minute Order: The 2005 Statewide Mobility Program

- Each year, the MPOs representing each Texas metropolitan area (TMA) identify projects for inclusion in TxDOT's Unified Transportation Plan (UTP), which covers the following 10 years
- The Statewide Mobility Program (SMP) is one of two documents that together constitute the Unified Transportation Plan
  - The SMP includes the "Build It" budget strategy
  - Category 2 of the SMP corresponds to TMA corridor construction projects
- Highway projects included in the 2005 SMP reflect the projects that Texas MPOs submitted to TxDOT in Fall 2004
  - This information can be interpreted as the MPOs initial response to the Texas Transportation Commission's Minute Order requiring that controlled-access road projects under development be evaluated for tolling

Texas Metropolitan Areas Comparison: Statewide Mobility Program

Tolled Lane-Miles included in Category 2 of the 2005 and 2007 SMPs

TMA	2005 Category 2 Tolled Lane-Miles	Draft 2007 Category 2 Tolled Lane-Miles
Austin	150	148
Corpus Christi	0	48
Dallas / Forth Worth	171	529
El Paso	0	0
Houston	30	444
Lubbock	0	0
Pharr	30	75
San Antonio	124	247

- According to the information contained in the 2005 SMP, Austin's initial proposals for toll road development were among the most extensive in Texas
- However, since then other Texas TMAs have adopted more aggressive tolling plans, as can be seen in the Draft 2007 SMP

Texas Metropolitan Areas Comparison: Statewide Mobility Program

SMP Category 2 programmed funding (000$)

TMA	2004 Category 2 Programmed Funding	2005 Category 2 Programmed Funding	Draft 2007 Category 2 Programmed Funding
Austin	$273,239	$719,743	$780,942
Corpus Christi	$79,504	$288,920	$314,868
Dallas / Forth Worth	$1,788,251	$2,674,014	$3,033,733
El Paso	$293,442	$532,941	$371,843
Houston	$2,038,567	$2,091,049	$1,446,626
Lubbock	$112,124	$88,463	$50,000
Pharr	$224,150	$180,475	$237,983
San Antonio	$633,208	$560,964	$632,656

- **The Austin TMA had one of the largest increases in Category 2 funding between 2004 and 2005**
- **The Draft 2007 SMP shows that Austin's funding level will remain high**
- **The Appendix has general information about the responses of other Texas MPOs.**

Response of Austin Area to the Situation

Comparison of Austin Area to National Peers

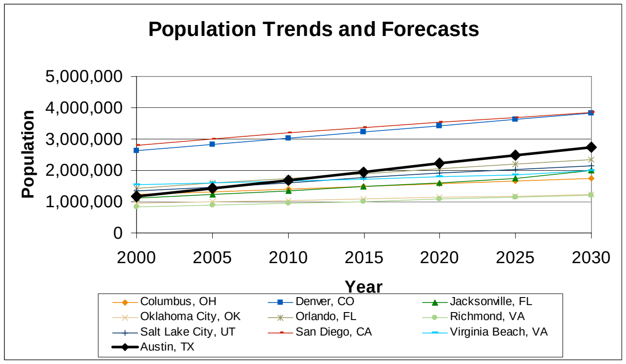
National peer comparison: Areas, selection and comparison criteria

In order to understand the Austin situation, we identified 9 peer urban areas

- **The criteria we used in choosing comparison cities were:**
  - **3 urban areas identified by Austin agencies**
    - **Orlando FL (pop. 1,157,431)**
    - **San Diego CA (pop. 2,674,436)**
    - **Virginia Beach VA (pop. 1,394,439)**
  - **6 urban areas with population rankings within 20 of Austin (pop. 901,920)**
    - **Denver CO (pop. 1,984,887)**
    - **Columbus OH (pop. 1,133,193)**
    - **Salt Lake City UT (pop. 887,650)**
    - **Jacksonville FL (pop. 882,295)**
    - **Richmond VA (pop. 818,836)**
    - **Oklahoma City OK (pop. 747,003)**
- **We compared Austin to these peer areas using the following indicators:**
  - **Forecast population growth to 2030**
  - **Forecast growth in Vehicle-Miles of Travel (VMT) to 2030**
  - **Historic Travel Time Index growth**
  - **Percent of currently tolled highway lane-miles**
  - **Estimated levels of tolled future highway lane-miles**

National peer comparison: Population

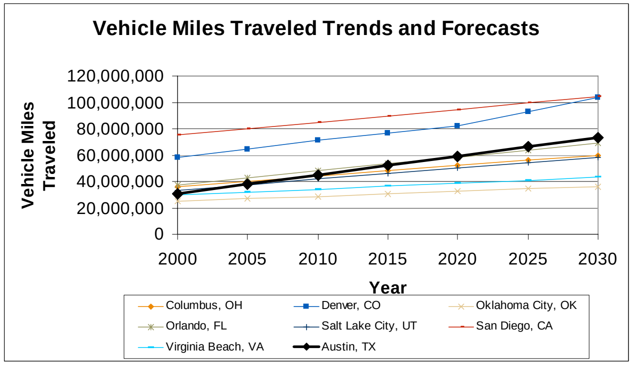
- **The Austin area's population is predicted to grow 137% from 2000 to 2030**
- **This is the highest growth of the urban areas considered**
  - **The Jacksonville area is the next highest with 80% growth**



Source: MPO Long Range Plans
Notes: Population forecasts for entire geographic coverage of associated MPO

National peer comparison: Vehicle-Miles of Travel

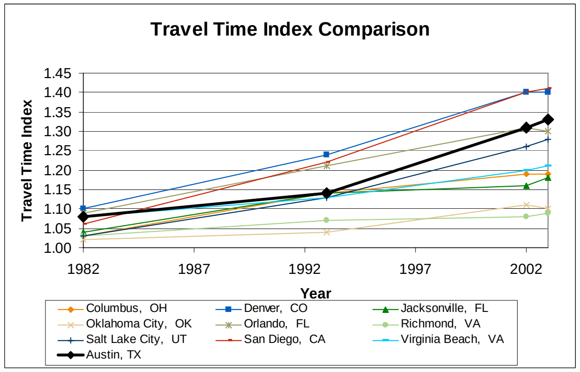
- **Austin area VMT is predicted to grow 139% from 2000 to 2030**
- **This is the highest VMT growth of the urban areas considered**
  - **The Denver area is the next highest with 79% growth**



Source: MPO Long Range Plans
Notes: VMT forecasts for entire geographic coverage of associated MPO

National peer comparison: Congestion

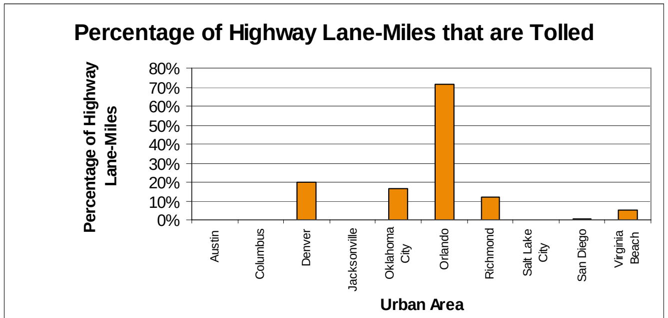
- **Austin's Travel Time Index has grown from 1.08 in 1982 to 1.33 in 2003**
- **Of the urban areas reviewed, only San Diego (1.06 to 1.41) and Denver (1.10 to 1.40) experienced more growth during this period**



Source: Texas Transportation Institute's (TTI) Urban Mobility Report
Notes: Travel time index values for geographic coverage of urban area considered by TTI

National peer comparison: Current development of toll roads

- **The current use of tolling varies widely among peer urban areas**
- **Austin has less highway lane-miles than the other urban areas considered**

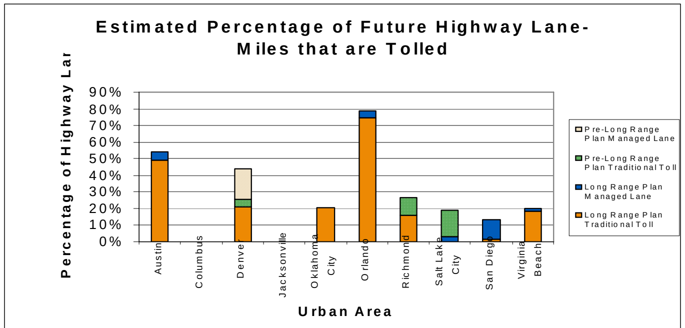


	Austin	Columbus	Denver	Jacksonville	Oklahoma City	Orlando	Richmond	Salt Lake City	San Diego	Virginia Beach
Total Highway Lane-Miles	470	825	1,129	643	782	881	1,104	493	2,077	770
Average Toll Rates ($/mile)										
Standard Toll			0.21		0.05	0.11	0.20			0.19
Managed Lane									0.50	

Source: CRA International
Notes: Lane-miles calculated for limited access highways contained in Census Bureau Urbanized Area

National peer comparison: Planned future development of toll roads

The planned future use of tolling is more extensive



Toll Lane-Miles:										
Standard Toll	768	0	344	0	209	875	336	109	48	184
Managed Lane	78	0	310	0	0	47	0	20	309	11

Source: CRA International
Notes: Lane-miles calculated for limited access highways contained in Census Bureau Urbanized Area
Future lane-miles identified from projects located in Census Bureau Urbanized Area and included in associated MPO long range plans

Comparison of Austin Area to Texas Peers

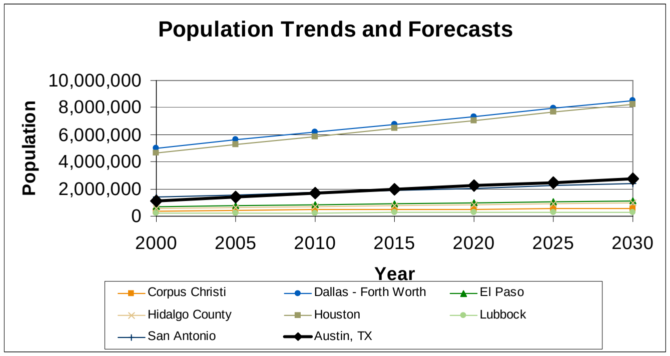
Texas peer comparisons

We also considered the Austin area (three-county CAMPO area) relative to the other Texas MPOs

- **The other Texas MPOs are:**
  - **Corpus Christi MPO**
  - **Dallas-Fort Worth (North Central Texas Council of Governments)**
  - **El Paso MPO**
  - **Hidalgo County MPO**
  - **Houston (Houston-Galveston Area Council)**
  - **Lubbock MPO**
  - **San Antonio (San Antonio-Bexar County MPO)**
- **We compared Austin to these peer cities using the following indicators:**
  - **Forecast population growth to 2030**
  - **Forecast growth in Vehicle-Miles of Travel to 2030**
  - **Historic Travel Time Index growth**
  - **Percent of currently tolled highway lane-miles**
  - **Estimated levels of tolled future highway lane-miles**

Texas peer comparison: Population

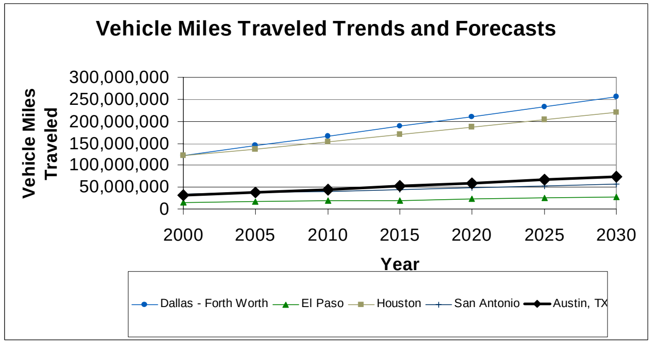
- **The Austin area's population growth of 137% from 2000 to 2030 is the highest among Texas MPOs, too**
  - **The Hidalgo County MPO is the next highest with 75% growth**



Source: MPO Long Range Plans
Notes: Population forecasts for entire geographic coverage of associated MPO

Texas peer comparison: Vehicle-Miles of Travel

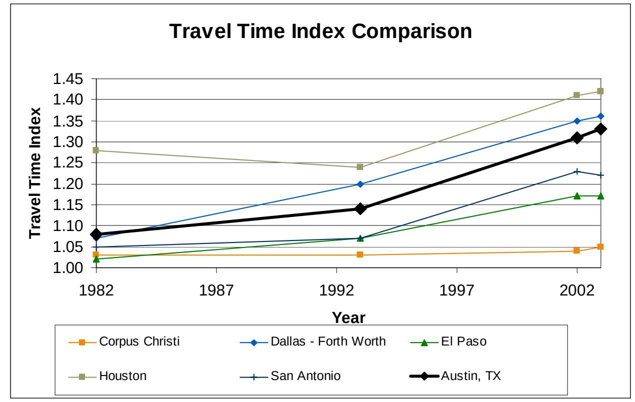
- **The Austin area's VMT growth of 139% from 2000 to 2030 is the highest in Texas, too**
  - **The NCTCOG has the next highest with 109% VMT growth in this period**



Source: MPO Long Range Plans
Notes: VMT forecasts for entire geographic coverage of associated MPO

Texas peer comparison: Congestion

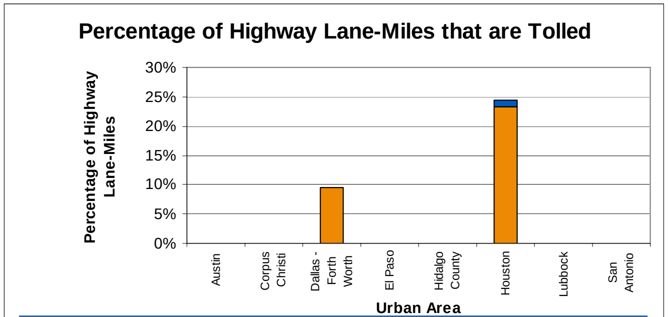
- **Austin's Travel Time Index has grown from 1.08 in 1982 to 1.33 in 2003**
- **Of the Texas MPOs, only NCTCOG (1.07 to 1.36) experienced more growth**



Source: Texas Transportation Institute's (TTI) Urban Mobility Report
Notes: Travel time index values for geographic coverage of urban area considered by TTI

Texas peer comparison: Current toll road development

Only NCTCOG and HGAC currently have tolled facilities

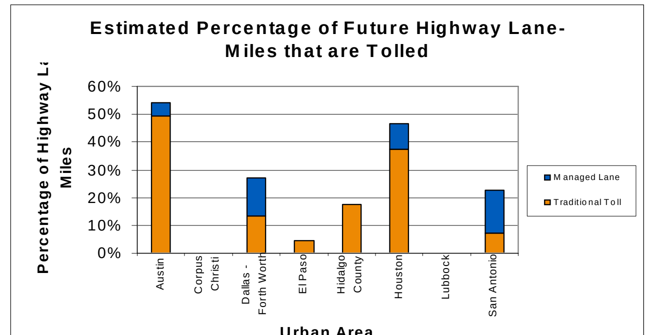


	Austin	Corpus Christi	Dallas - Forth Worth	El Paso	Hidalgo County	Houston	Lubbock	San Antonio
Total Highway Lane-Miles	470	299	3,243	392	312	2,625	166	1,063
Average Toll Rates ($/mile)								
Standard Toll			0.10			0.14		
Managed Lane						0.15		

Source: CRA International
Notes: Lane-miles calculated for limited access highways contained in associated Census Bureau Urbanized Area

Texas peer comparison: Planned future toll road development

Most Texas MPOs are pursuing some level of tolling for the future

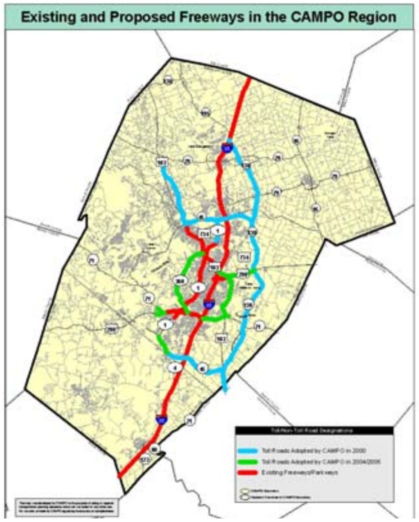


	Austin	Corpus Christi	Dallas - Forth Worth	El Paso	Hidalgo County	Houston	Lubbock	San Antonio
Toll Lane-Miles:								
Standard Toll	768	0	727	32	72	1468	0	148
Managed Lane	78	0	741	0	0	366	0	315

Source: CRA International
Notes: Lane-miles calculated for limited access highways contained in associated Census Bureau Urbanized Area

Austin Area Response: The Phase 2 Toll Plan

The Phase 2 Toll Plan



Phase 2 Toll Plan: Project characteristics

Projects	Const. Year	Opening Year	Construction Cost Estimate ($2006)
SH45 SW	2013	2015	$74,978,220
SH 71 E	2012	2014	$496,333,763
US 183 S	2009	2012	$575,002,272
US 290 W /SH 71 W	2010	2013	$217,046,879
US 290 E	2010	2013	$584,715,200
Loop 360	2008	2013	$741,288,000
Total			***$2,689,364,334***
Total (excluding Loop 360)			***$1,948,076,334***

Sources:

Cost estimate: PBS&J, dated 3/29/2006
Opening year: URS Draft Sketch Level Planning Traffic and Revenue Study
Construction period duration: TxDOT 2004 Toll Feasibility Analysis Studies

Notes on the background material

Effective Fuel Tax Rates

We used the Consumer Price Index to convert Texas and Federal tax rates into constant 1990 dollars.

Sources:
Texas Gasoline Tax Rate: Federal Highway Administration's *Highway Statistics 2004*, Table MF-205.
Federal Tax Rate: Buecher, Dr. William, "History of Gasoline Tax", American Road and Transportation Builders Association, downloaded from http://www.artba.org/economics_research/reports/gas_tax_history.htm, last referenced, 5/17/2006
Historical Inflation: U.S. Department of Labor, Bureau of Labor Statistics, Consumer Price Index Series ID CUUR0000SA0, Extracted May 17, 2006

Federal Highway Trust Fund Income

We used the Consumer Price Index to convert Federal Highway Trust Fund Income into constant 1990 dollars.

Sources:
Federal Highway Trust Fund Income: Federal Highway Administration's *Highway Statistics 2004*, Table FE-210, column labeled "Total (Net Income)"
Historical Inflation: U.S. Department of Labor, Bureau of Labor Statistics, Consumer Price Index Series ID CUUR0000SA0, Extracted May 17, 2006

Notes:
The graph of Highway Trust Fund Income has a spike in 1999. The following explanation was provided by Ralph Erickson of FHWA via email on September 14, 2006.

"For the 1998 to 1999 time frame question: Section 901 (e) of the Taxpayer Relief Act of 1997, instructed the Treasury Department to delay deposits of motor fuel revenue by oil companies for the August and September 1998 period, but that revenue was to be reported by October 5, 1998. The effect was to move about $6 billion ($5 billion for the Highway Account of the HTF, and $1 billion for the Mass Transit Account of the HTF) from federal FY 1998 to FY 1999. Hence the too low data for the earlier year and the too high data for the second year, on a cash-accounting basis. The attached table from Highway Statistics, 1999 gives the details.

The other trend you notice is the fall in revenue as a result of the economic recession that began in mid-year 2000 (the high-tech bubble bust), that affected 2001- 2003 data."

Construction Cost Indices

We adjusted construction cost indices to reflect a 1996 base.

Sources:
Turner Construction Cost Index: downloaded from http://www.turnerconstruction.com/corporate/content.asp?d=20 on May 17, 2006

Army Corps of Engineers: US Army Corps of Engineers Civil Works Construction Cost Index System (CWCCIS), EM 1110-2-1304, Revised as of March 31, 2006

Engineering News-Record: Grogan, Tim. "Construction Cost Index History (1918-2006)". Engineering News-Record. March 20, 2006. Cost Report 1Q Section, Indexes, 256(11):40

Historical Inflation: U.S. Department of Labor, Bureau of Labor Statistics, Consumer Price Index Series ID CUUR0000SA0, Extracted May 17, 2006

Highway Expenditures

Capital and maintenance expenditures were converted to 1990 dollars using CPI data in the *Highway Statistics 2004* file.

Sources:
Highway Expenditures (both capital and maintenance) and Consumer Price Index: Federal Highway Administration's *Highway Statistics 2004*, available at http://www.fhwa.dot.gov/policy/ohim/hs04/xls/cpicht.xls, provides highway expenditures for all units of government.

National Urban Lane-Miles of Interstate, Freeway, Expressway, and Arterial Highways

For each year, we added together the values of the Urban "Interstate", "Other Freeways and Expressways", "Other Principal Arterials", and "Minor Arterials" columns of the FHWA *Highway Statistics* publication for that year in order to develop an urban lane-miles total.

Source: Federal Highway Administration's *Highway Statistics*
1980 – 1995: *Highway Statistics Summary to 1995* Table HM-260

1996-2004: Each year's *Highway Statistics* Table HM-60, US Total

Trends in Urban Lanes, Travel, and Delay

For each measure, we collected a time series of values for the period of 1982 – 2003, and then divided each year's value by the 1982 value to develop the index. We used linear interpolation to determine Urban Delay for intermediate years between 1982, 1993, 2002, and 2003 which are provided in the 2005 *Urban Mobility Report*.

Sources:

Urban Highway Lane Miles: Federal Highway Administration's *Highway Statistics*
1982 – 1995: *Highway Statistics Summary to 1995* Table HM-260

1996-2004: Each year's *Highway Statistics* Table HM-60, US Total

Urban Vehicle Miles Traveled: Federal Highway Administration's *Highway Statistics*
1982 – 1995: *Highway Statistics Summary to 1995* Table VM-201, Sheet 4 of 4, rows "All Motor Vehicles – Urban Interstate" and "All Motor Vehicles – Other Urban Streets"

1996-2004: Each year's *Highway Statistics* Table VM-1, "All Motor Vehicles" column for "All Urban" row

Urban Delay: Schrank, David and Tim Lomax, Texas Transportation Institute, *The 2005 Urban Mobility Report*, Table 4 Trends – Annual Delay per Traveler, 1982 to 2003, 85 Urban Area average

Peer Comparison

A portion of the project's background research consisted of a comparison of the Austin area with other US urban areas. Early in the project, three areas that commonly serve as points of comparison to the Austin area were identified: 1) Orlando FL, 2) San Diego CA, and 3) Virginia Beach VA. We then selected six other areas to compare the Austin area to, by choosing cities that have similar populations. Specifically, we reviewed the 2000 Census population rankings of Urbanized Areas and Urban Clusters and selected the following six from those urbanized areas that ranked within 20 of Austin:

1) Denver CO
2) Columbus OH
3) Salt Lake City UT
4) Jacksonville FL
5) Richmond VA
6) Oklahoma City OK

Population Trends and Growth / VMT Population Trends and Growth

In order to identify forecasts of population and vehicle miles traveled (VMT) for each peer city, we researched the Long Range Transportation Plans of the MPO associated with each peer city. We recognize that MPO boundaries cover a larger area than the areas contained within the boundaries of the urbanized areas, but MPOs provide the best source for future forecasts of population and VMT.

We developed the population and VMT curves using values and forecasts available in the MPO Long Range Plans. Not all MPO Long Range Plans provide forecasts for the same years, and thus we interpolated and extrapolated available forecast year values into the population curves presented in the figure. Some MPOs do not provide information on levels of VMT, and therefore, we do not present VMT curves for these urbanized areas. For Jacksonville, FL, we were only able to obtain a summary of the MPO's long range plan, but combining information from the summary along with profile information for the MPO, we were able to establish population forecasts.

Sources:

Austin: Capital Area Metropolitan Planning Organization, *CAMPO Mobility 2030 Plan,* Adopted June 6, 2005

Columbus OH: Mid-Ohio Regional Planning Commission, *2030 Regional Transportation Plan*, June 10, 2004

Denver CO: Denver Regional Council of Governments, *2030 Metro Vision Regional Transportation Plan*, January 2005

Jacksonville FL: First Coast MPO, *The Future of First Coast Transportation is Now: 2030 Long Range Transportation Plan – Summary*

and First Coast MPO, *MPO Profile*

Oklahoma City OK: Oklahoma City Area Regional Transportation Study, *2025 OCARTS Plan Report*, December 2001 (Note: 2030 plan not available for download at time of data collection)

Orlando FL: Metroplan Orlando, *Community Connections: A Transportation Vision for the Next 25 Years*, Adopted September 2004

Richmond VA: Richmond Area MPO, *2026 Long-Range Transportation Plan*, April 2004

Salt Lake City UT: Wasatch Front Regional Council, *Wasatch Front Urban Area Long Range Transportation Plan Update 2004 – 2030*, December 2003

San Diego CA: San Diego Association of Governments, *2030 Revenue Constrained Regional Transportation Plan: 2006 Update,* February 2006

Virginia Beach VA: Hampton Roads Planning District Commission, *Hampton Roads 2026 Regional Transportation Plan: Technical Document*, June 2004

Travel Time Index Growth

The *Urban Mobility Report* provides travel time index values for each of the urban areas associated with our peer cities. We plotted the travel time index values without making any adjustments.

Source: Schrank, David and Tim Lomax, Texas Transportation Institute, *The 2005 Urban Mobility Report*, Table 5 Trends – Travel Time Index, 1982 to 2003

Percent of currently tolled highway lane-miles

The objective of this analysis was to determine the total amount of limited access lane-miles contained within the boundaries of each Urbanized Area, and the share of those lane-miles that are tolled. We used Geographic Information Systems (GIS) methods to conduct this analysis, relying heavily on software (TransCAD) and data from Caliper Corporation. . During our analysis, we encountered ring roads around cities that extend beyond the boundaries of the Urbanized Areas; since these facilities are major components of their urban area's highway infrastructure, we decided to include these relevant limited access roads.

For information on limited access highways, we started with Caliper's "ccMajorRoad" layer. This GIS layer contains information concerning access type, number of lanes, and tolling, with the number of lanes and access type information coming from version 4 of the National Highway Planning Network (NHPN), a geospatial dataset of significant roads maintained by the Federal Highway Administration for use in planning. Caliper explains that the toll information comes from "various paper maps, digital data, and knowledge of the areas." We used FHWA's latest version of the NHPN to update the number of lanes and open to traffic status, and Caliper's "ccMajorRoad" file to update toll and access control information for some roads, since Caliper indicates that it includes better information for some roads. The NHPN did not include the number of lanes for some roads; we assumed that these roads had 4 lanes (2 lanes in each direction), unless we had first-hand knowledge of the roads.

For validation, and to help populate missing information, we compared the information in our highway layer to various commercial mapping products. Rand McNally, Navteq, and Tele Atlas all maintain map databases that contain access control and toll information. While these databases are all prohibitively expensive to purchase, the information can be thematically observed on various mapping websites. Finally, we used knowledge of the status of early managed lane projects to differentiate traditional toll lanes from managed lanes, where managed lanes include High Occupancy / Toll lanes (HOT lanes), Express Lanes, or Truck-Only Toll Lanes (TOT lanes).

Once our highway database was complete, we summed the total lane-miles and tolled lane-miles for each urbanized area. For peer cities with toll lanes, we reviewed the toll rates of the agencies that operate the toll roads in order to provide the average current toll rates for each urbanized area. For a more complete description of average toll rates, see our description of “*National Average Toll Rate*”.

Toll rates and toll lane-miles available for travel were last updated in July 2006.

Sources, GIS files:

Caliper Corporation, “ccHighway”, Highway lines, based on the National Highway Planning Network Version 4.0

Caliper Corporation, “ccMajorRoad”, Caliper’s modified and improved version of ccHighway.

Caliper Corporation, “ccUrbanArea_Cluster”, 2000 Urbanized Areas and Urban Clusters area file

Federal Highway Administration, “National Highway Planning Network” (NHPN) version August 2005

Estimated levels of tolled future highway lane-miles

The next phase of the tolled lane-mile analysis was to develop estimates of how the share of tolled lane-miles would change in the future. To do this, we utilized information in the MPO Long Range Plans for CAMPO and all the MPOs associated with the peer cities.

It is important to note that while MPO Long Range Plans are required respect financial constraints, not all projects included in these plans will necessarily be built. Further, during the planning horizon, project definitions – including tolling status – may change. If changes in tolling status occur, they are likely to result in more tolling as transportation departments across the country confront their growing financial challenges.

Also note that details included in the descriptions of future limited access expansion and widening vary by MPO: some provide abundant details while others provide little. We used the available information and engineering judgment to update our limited access highway lane-mile database to develop estimates of future lane-miles and the shares that will be tolled.

For a few peer cities, we found information indicating future tolled lane projects that had not yet been included and adopted in the MPO’s Long Range Plan[1]. We included this information in our analysis, but indicated this less-definitive level by labeling as “Pre-Long Range Plan”.

Sources:

GIS files:

Caliper Corporation, “ccHighway”, Highway lines, based on the National Highway Planning Network Version 4.0

Caliper Corporation, “ccMajorRoad”, Caliper’s modified and improved version of ccHighway.

Caliper Corporation, “ccUrbanArea_Cluster”, 2000 Urbanized Areas and Urban Clusters area file

Federal Highway Administration, “National Highway Planning Network” (NHPN) version August 2005

[1] This includes a few projects in Richmond, VA that were included in the Long Range Plan in a category called “Private / Local Projects”.

MPO Long Range Plans:

Austin: Capital Area Metropolitan Planning Organization, *CAMPO Mobility 2030 Plan,* Adopted June 6, 2005

Columbus OH: Mid-Ohio Regional Planning Commission, *2030 Regional Transportation Plan*, June 10, 2004

Denver CO: Denver Regional Council of Governments, *2030 Metro Vision Regional Transportation Plan*, January 2005

Jacksonville FL: First Coast MPO, *The Future of First Coast Transportation is Now: 2030 Long Range Transportation Plan – Summary*

Oklahoma City OK: Oklahoma City Area Regional Transportation Study, *2025 OCARTS Plan Report*, December 2001 (Note: 2030 plan not available for download at time of data collection)

Orlando FL: Metroplan Orlando, *Community Connections: A Transportation Vision for the Next 25 Years*, Adopted September 2004

Richmond VA: Richmond Area MPO, *2026 Long-Range Transportation Plan*, April 2004

Salt Lake City UT: Wasatch Front Regional Council, *Wasatch Front Urban Area Long Range Transportation Plan Update 2004 – 2030*, December 2003

San Diego CA: San Diego Association of Governments, *2030 Revenue Constrained Regional Transportation Plan: 2006 Update,* February 2006

Virginia Beach VA: Hampton Roads Planning District Commission, *Hampton Roads 2026 Regional Transportation Plan: Technical Document*, June 2004

Other future toll road information:

Denver CO: Colorado Tolling Enterprise, "Statewide Toll Feasibility Second-Tier Analysis", presentation from December 15, 2004

Colorado Tolling Enterprise, "CTE Preliminary Traffic and Revenue Study", prepared by Wilbur Smith Associates, HNTB Corporation, Felsburg, Holt & Ullevig, and Citigroup, December 2004

Salt Lake City UT: Utah Department of Transportation, "Utah Managed Lane Study", 2005

Texas Metropolitan Area Comparison

We repeated the comparison to peer US cities, but this time to the other Texas Metropolitan areas:

1) Corpus Christi
2) Dallas - Forth Worth
3) El Paso
4) Hidalgo County
5) Houston
6) Lubbock
7) San Antonio

Population Trends and Growth / VMT Population Trends and Growth

We developed population and VMT trends and growth forecasts from information contained in the MPO Long Range Plans associated with each of the Texas Metropolitan Areas, interpolating and extrapolating available data.

Sources:

Austin: Capital Area Metropolitan Planning Organization, *CAMPO Mobility 2030 Plan,* Adopted June 6, 2005

Corpus Christi: Corpus Christi MPO, *Corpus Christi Metropolitan Transportation Plan Fiscal 2005 – 2030*,

Dallas - Forth Worth: North Central Texas Council of Governments Transportation Department, *Mobility 2025: The Metropolitan Transportation Plan*, Amended 2005

El Paso: El Paso Metropolitan Planning Organization, *2030 Metropolitan Plan – the Plan: A Vision in Mobility*

Hidalgo County: Hidalgo County Metropolitan Planning Organization, *2005 – 2030 Metropolitan Transportation Plan*

Houston: Houston-Galveston Area Council, *2025 Regional Transportation Plan Houston-Galveston Area*, Approved June 2005

Lubbock: Lubbock Metropolitan Planning Organization, *Lubbock Metropolitan Plan: 2030*, Adopted October 2004

San Antonio: San Antonio-Bexar County Metropolitan Planning Organization, *Mobility 2030 San Antonio – Bexar County Metropolitan Transportation Plan*, Adopted December 2004

Travel Time Index Growth

The *Urban Mobility Report* provides travel time index values for each of the Urbanized Areas associated with the Texas Metropolitan Areas. We plotted the travel time index values without making any adjustments.

Source: Schrank, David and Tim Lomax, Texas Transportation Institute, *The 2005 Urban Mobility Report*, Table 5 Trends – Travel Time Index, 1982 to 2003

Percent of currently tolled highway lane-miles

We extended the lane-mile analysis, described under the *Peer Comparison - Percent of currently tolled highway lane-miles* above, to the Texas Metropolitan Areas. Again, toll rates and toll lane-miles available for travel were last updated in July 2006.

Sources, GIS files:

Caliper Corporation, “ccHighway”, Highway lines, based on the National Highway Planning Network Version 4.0

Caliper Corporation, “ccMajorRoad”, Caliper’s modified and improved version of ccHighway.

Caliper Corporation, “ccUrbanArea_Cluster”, 2000 Urbanized Areas and Urban Clusters area file

Federal Highway Administration, “National Highway Planning Network” (NHPN) version August 2005

Estimated levels of tolled future highway lane-miles

We extended the future lane-mile analysis, described under the *Peer Comparison – Estimated levels of tolled future highway lane-miles* above, to the Texas Metropolitan Areas.

Sources:

GIS files:

Caliper Corporation, "ccHighway", Highway lines, based on the National Highway Planning Network Version 4.0

Caliper Corporation, "ccMajorRoad", Caliper's modified and improved version of ccHighway.

Caliper Corporation, "ccUrbanArea_Cluster", 2000 Urbanized Areas and Urban Clusters area file

Federal Highway Administration, "National Highway Planning Network" (NHPN) version August 2005

MPO Long Range Plans:

Austin: Capital Area Metropolitan Planning Organization, *CAMPO Mobility 2030 Plan,* Adopted June 6, 2005

Corpus Christi: Corpus Christi MPO, *Corpus Christi Metropolitan Transportation Plan Fiscal 2005 – 2030,*

Dallas - Forth Worth: North Central Texas Council of Governments Transportation Department, *Mobility 2025: The Metropolitan Transportation Plan*, Amended 2005

El Paso: El Paso Metropolitan Planning Organization, *2030 Metropolitan Plan – the Plan: A Vision in Mobility*

Hidalgo County: Hidalgo County Metropolitan Planning Organization, *2005 – 2030 Metropolitan Transportation Plan*

Houston: Houston-Galveston Area Council, *2025 Regional Transportation Plan Houston-Galveston Area*, Approved June 2005

Lubbock: Lubbock Metropolitan Planning Organization, *Lubbock Metropolitan Plan: 2030*, Adopted October 2004

San Antonio: San Antonio-Bexar County Metropolitan Planning Organization, *Mobility 2030 San Antonio – Bexar County Metropolitan Transportation Plan,* Adopted December 2004

National Average Toll Rate

For each toll facility, we calculated a toll rate by dividing the end-to-end toll cost by the end-to-end toll road length. We calculated a national average toll rate by taking a simple average of each agency's toll rate. Toll rates were last updated in July 2006.

Statewide Mobility Program Analysis

It is our understanding that the first detailed response to the TTC Minute Order 109519, dated December 18, 2003, was the information that each Texas Metropolitan Area (TMA), through the associated MPO, submitted to TxDOT for inclusion in the 2005 Statewide Mobility Program (SMP). We reviewed the 2004, 2005 and draft 2007 versions of the SMP to obtain indications about how the different TMAs responded to the Minute Order and about the resulting amount of programmed funding for each TMA. We recognize that there are many factors that contribute to the yearly changes in the programmed funding totals for each District. However, it is likely that the programmed funding levels reflect to some degree TxDOT's response to each district's adoption of the Minute Order principles.

Category 2 of the SMP deals with highway corridors in TMAs. We reviewed the Category 2 projects listed in the SMP to identify the tolling projects that each TMA submitted to

TxDOT for the 2005 and 2007 SMPs. The SMP project listings provide information relating to each project, including a brief project description and the project length. We reviewed the descriptions and identified projects that appear to incorporate some level of toll financing; for 2007, this identification was aided by a label of "Toll Candidate" associated with projects for which studies suggest that they are conducive to tolling. For these toll projects, we calculated the number of toll lane-miles being added. In many cases this was straightforward, as the length was provided and the number of lanes was included in the description. In other cases, we used engineering judgment to populate the missing information. We summed the total lane-miles for each TMA. We added the totals for the Dallas and the Fort Worth TMAs together. We also reviewed the table of total Category 2 programmed funding of 2004, 2005, and 2007. Again we combined Dallas and Fort Worth TMAs.

Sources:

Texas Department of Transportation, *2004 Statewide Mobility Program*

Texas Department of Transportation, *2005 Statewide Mobility Program*

Texas Department of Transportation, *Draft 2007 Unified Transportation Program: Statewide Mobility Program*

Sources:

Agency	**Website Source**
California Private Transportation Company, L.P.	http://www.91expresslanes.com/tollschedules.asp?p=m3
Transportation Corridor Agencies	http://www.thetollroads.com/home/maps.htm
SANDAG, I-15, California	http://argo.sandag.org/fastrak/schedule.html
Northwest Parkway Public Highway Authority	https://expresstoll.com/Default.aspx?tabid=49
Delaware Department of Transportation	http://www.deldot.net/static/Community_programs_services/tollrates/frequent_user_plan.html
Orlando-Orange County Expressway Authority	http://www.oocea.com/mapsandtravelinfo/tollcalculator.php3
Miami-Dade Expressway Authority (MDX)	http://www.mdx-way.com/facts_increases.cfm
Florida Department of Transportation Florida's Turnpike	http://www.dot.state.fl.us/turnpikepio/TollCalculator/TRI/index.htm
Tampa-Hillsborough Expressway Authority	http://www.tampa-xway.com/toll/calculator.html
State Road and Tollway Authority	http://www.georgiatolls.com/SRTAExternal/jsp/content/tollSchedule.jsp
The Illinois State Toll Highway Authority	http://www.illinoistollway.com/portal/page?_pageid=53,35497,53_35518&_dad=portal&_schema=PORTAL
Skyway Concession Company	http://www.chicagoskyway.org/
Indiana Department of Transportation Toll Road District	http://www.in.gov/dot/div/tollroad/tollschedule.pdf
Kansas Turnpike Authority	http://ksturnpike.com/tolls/tolls.html
Kentucky Division of Toll Facilities	http://www.kytc.state.ky.us/toll/home.htm
Massachusetts Turnpike Authority	http://www.massturnpike.com/user-cgi/tollcalc.cgi
Maryland Transportation Authority	http://www.mdta.state.md.us/mdta/servlet/dispatchServlet?url=/TollRates/ratesIndex.jsp
Maine Turnpike Authority	http://www.ezpassmaineturnpike.com/info/tollratecharts.html
South Jersey Transportation Authority	http://www.acexpressway.com/ezpass.html
New Jersey Highway Authority	http://www.state.nj.us/turnpike/gsptollsched.pdf
New Jersey Turnpike Authority	http://www.state.nj.us/turnpike/nj-vcenter-tollrates.htm

Agency	**Website Source**
New Hampshire Department of Transportation - Bureau of Turnpikes	http://www.nh.gov/dot/turnpikes/pdf/tollrates.pdf
New York State Thruway Authority	http://www.thruway.state.ny.us/tolls/calc/toll-tickets.html
Ohio Turnpike Commission	http://www.ohioturnpike.org/faresch.html
Oklahoma Transportation Authority	http://www.pikepass.com/toll%20rate%20calc/querytllrts.aspx?Turnpike=HE+Bailey
E-470 Public Highway Authority	http://www.407etr.com/tolls/tolls.asp
Pennsylvania Turnpike Commission	http://www.paturnpike.com/toll/tollmileage.aspx
Connector 2000 Association	http://www.southernconnector.com/home.htm
Harris County Toll Road Authority	http://www.hctra.com/system/rates.html
North Texas Tollway Authority	http://www.ntta.org/pub/pub/pub_tolls.jsp
Pocahontas Parkway Association	http://www.pocahontasparkway.com/ratesPR.html
Richmond Metropolitan Authority	http://www.rmaonline.org/Facilities/toll_operations.htm
Virginia Department of Transportation	http://www.virginiadot.org/comtravel/faq-toll.asp
Chesapeake Expressway	http://www.chesapeakeexpressway.com/discount.cfm
Dulles Greenway (TRIP II)	http://www.dullesgreenway.com/cgi-bin/dgtolls2.cfm?home=dg
West Virginia Parkways, Economic Development and Tourism Authority	http://www.wvturnpike.com/rates.html

Part 2: Analysis of the Phase 2 Toll Plan and Alternatives

Alternative ways to build and operate the Phase 2 roadways

The MAFS Scope of Work asks about alternative financing and traffic management models to build Phase 2 roadways

- It specifically mentions three alternative concepts
  - A mixture of non-tolled lanes and managed lanes
  - A mixture of non-tolled lanes and managed lanes with congestion pricing
  - A mixture of non-tolled lanes and high occupancy toll (HOT) lanes
- We will refer to all of these as *managed lane concepts*
- Managed lanes = a generic term that refers to a situation where specific lanes on a roadway are restricted for use by certain vehicles and actively operated, generally by tolling; the other lanes are general purpose
- We discussed with members of the MAFS Steering Committee, the Technical Advisory Committee, CAMPO and CTRMA the precise definition of these concepts and the most appropriate analysis approach

Definition of managed lane concepts to be analyzed

- Express Lanes consist of a mixture of non-tolled and managed lanes
  - Here we have taken managed lanes to mean lanes that can be used by any vehicle that pays a toll
  - The toll is fixed and does not vary by time of day or other factor
- Express Lanes CP consist of a mixture of non-tolled lanes and managed lanes with congestion pricing
  - Congestion pricing refers to a situation where a vehicle pays higher charges at higher levels of congestion
  - Different forms of congestion pricing have been proposed and implemented
  - Here we have taken it to mean time-of-day pricing:
    - Toll rates differ between the peak and off-peak periods
    - Toll rates are fixed within each period
    - Toll rates apply uniformly on a project but may vary between projects
- HOT Lanes consist of a mixture of non-tolled lanes and high-occupancy toll lanes
  - HOT lanes are lanes that can be used without charge by high-occupancy vehicles (HOVs): any passenger vehicle with 2 or more occupants
  - Single-occupant vehicles (SOVs) can use HOT lanes if a toll is paid

Application of managed lane concepts

- We assume that each managed lane concept applies uniformly across the entire set of Phase 2 roadways
  - All Phase 2 roadways are implemented as either Express Lanes, Express Lanes CP or HOT Lanes (though possibly at different times)
  - In each concept, we assume that each roadway's alignment and cross-section are the same as were proposed in the Phase 2 Toll Plan
  - Limited access main lanes (total 2, 3 or 4 lanes)
  - Main lanes consist of one managed lane with the remainder non-tolled
  - Parallel frontage roads provide access to local activities as well as short- or medium-distance mobility
- The toll rates used in this analysis are applied uniformly within projects and are distance-based. In 2006 dollars, the analyzed rates are:
  - Phase 2 Toll Plan: 12¢ / mile, Express Lanes: 12¢ / mile, same as above
  - Express Lanes CP: 10 - 24¢ / mile for peak periods, 2¢ / mile for off-peak; HOT Lanes: 10 - 33¢ / mile for peak periods, 4¢ / mile for off-peak; ditto
- Phase 2 Toll Plan and Express Lane toll rates based on those in recent *Sketch Level Planning Traffic and Revenue Study* of Phase 2 Toll Projects for CTRMA
- Express CP and HOT lane toll rates are set to provide premium travel service quality to managed lanes users

Other concepts considered

The MAFS Scope of Work asks about two additional methods for building the Phase 2 roadways

- Shadow tolls (or pass-through tolling)
  - An arrangement by which an outside agency pays an agreed amount for each vehicle that uses a particular road, as if the vehicle itself were paying a toll
  - Provided for in HB 3588
  - To our knowledge, no agency is willing to assume this level of financial responsibility for the proposed Phase 2 roadways
- Local option gas tax
  - Wes Burford of TxDOT Austin District has estimated that an additional 17¢/gallon gas tax in Hays, Williamson and Travis Counties, starting in 2011, would be required to cover the construction of and match the long-term revenue generation potential of the Phase 2 Toll Plan projects
  - Importantly, this assumes no tax evasion (drivers buy gas in other counties)
  - Also assumes that the proceeds of this tax are not capitalized
  - Separate analyses have indicated that a gas tax of around 5¢/gallon would generate enough revenue to fund construction, and of around 6¢/gallon would fund construction and maintenance of the Phase 2 roadways
  - If we assume that these increases (< 1¢/mile) in vehicle operating costs would have a negligible effect on travel behavior, the results of our no-toll analyses can be applied to the gas tax concept

Comparison criteria

- We compare the fully tolled, managed lanes and no toll alternatives
- We compare the impacts of these alternatives in terms of
  - Traffic impacts
  - Transportation benefits to drivers
  - Economic effects to the Central Texas region
  - Revenue generation
  - Financial feasibility
- Many of these impacts depend on the project timing (opening year)
- At the sketch level of detail of this analysis, the differences in construction and maintenance costs between the alternatives are not significant
  - Each alternative's cost is roughly the same as the toll project
- Analysis of the alternatives' traffic, transportation benefits and revenue impacts needs a travel forecasting model to predict traffic volumes, conditions and toll revenues
- In some cases, alternatives were evaluated against a base No Action alternative
  - The No Action alternative consists of 2030 Long Range Plan minus the Phase 2 Plan roadway projects
  - This is a hypothetical situation chosen purely for the purpose of comparing the other alternatives between themselves

Modeling approach

- CAMPO made its travel forecasting model available to us
  - It represents travel on all major road links in the three-county area
  - We sincerely thank the CAMPO directors and modeling staff for their assistance
- All our model runs were based on the input data that CAMPO used in the preparation of the 2030 Long Range Plan, and are for 2030 conditions
- We made a number of adaptations to the CAMPO model in order to improve its applicability to managed lanes
  - The CAMPO travel forecasting model, like almost all metropolitan travel forecasting models, was not originally designed to analyze managed lanes
- In brief, the adapted model predicts the amount of SOV and HOV traffic flowing on different available (non-tolled and tolled) paths
  - Based on the generalized cost (travel time and toll payment) of each path
  - Taking account of the effects of congestion on path travel times
- We believe that the adapted model is a suitable tool for comparing tolling and managed lane concepts in relative terms and on an equitable basis
- However:
  - Its outputs are to sketch planning (order of magnitude) accuracy levels
  - Because of differences in approach and detail, its outputs are not strictly comparable to those of other models applied in the Capital District

Traffic Impacts

Traffic impacts

- Regional (3 county) network performance
  - Vehicle-miles traveled (VMT) – total distance that cars travel on network
  - Vehicle-hours traveled (VHT) – total time that cars spend traveling
- Average AM and PM peak speeds
- Travel times for representative trips
  - For drivers who are willing to pay a toll
  - For drivers who are not willing to pay a toll
- Average traffic volumes relative to volumes on the fully tolled project
- These indicators were determined for each alternative by a run of the adapted CAMPO travel forecasting model
- All values are for 2030 conditions

Traffic impacts: CAMPO Regional-Level Traffic Performance

Percentage VMT and VHT change relative to the No Action base alternative, 2030

	VMT	VHT
Phase 2 Plan	-1.1%	-6.7%
Express Lanes	-1.2%	-7.9%
Express Lanes CP	-1.2%	-8.0%
HOT Lanes	-1.1%	-7.8%
Phase 2 Roads w/ No Tolls	-1.1%	-8.2%

- **There is little difference in the regional level of miles traveled between the Phase 2 Toll Plan and each of the managed lane concepts**
  - **All alternatives, including the Phase 2 Toll Plan, reduce total VMT by a little over 1%**
- **All alternatives significantly reduce VHT compared to the No Action situation**
  - **The managed lane concepts all reduce VHT more than the Phase 2 Toll Plan**

Note: VMT = Vehicle-Miles Traveled; VHT = Vehicle-Hours Traveled

Traffic impacts: CAMPO Regional-Level Traffic Performance

Percentage VMT and VHT change relative to Phase 2 Toll Plan, 2030

	VMT	VHT
Express Lanes	-0.04%	-1.23%
Express Lanes CP	-0.02%	-1.32%
HOT Lanes	0.00%	-1.19%
Phase 2 Roads w/ No Tolls	0.03%	-1.59%

- **All managed lane concepts reduce VHT relative to the Phase 2 Toll Plan**
- **There is little difference in the regional level of miles traveled between the Phase 2 Toll Plan and each of the managed lane concepts**

Note: VMT = Vehicle-Miles Traveled; VHT = Vehicle-Hours Traveled

Traffic impacts: Project-level speeds

SH 45 Southwest: Average Speeds for Tolled & Non-Tolled Lanes, 2030

	AM Peak		PM Peak	
	Tolled	Non-Tolled	Tolled	Non-Tolled
Phase 2 Plan	45	NA	42	NA
Express Lanes	47	35	43	33
Express Lanes CP	47	35	44	32
HOT Lanes	46	36	44	31
Phase 2 Roads w/ No Tolls	NA	42	NA	36

- **The managed lane concepts have minimally faster average speeds than the Phase 2 Toll Plan**
- **In all concepts, the managed lanes have average travel speeds 10+ mph faster than the non-tolled lanes**

Traffic impacts: Project-level speeds

SH 71 East: Average Speeds for Tolled & Non-Tolled Lanes, 2030

	AM Peak		PM Peak	
	Tolled	Non-Tolled	Tolled	Non-Tolled
Phase 2 Plan	39	NA	33	NA
Express Lanes	40	30	36	26
Express Lanes CP	40	31	36	25
HOT Lanes	40	31	38	25
Phase 2 Roads w/ No Tolls	NA	34	NA	27

- **In the AM, the managed lane concepts have minimally faster average speeds than the Phase 2 Toll Plan**
- **In the PM, the managed lane concepts provide faster speeds than the Phase 2 Toll Plan, particularly the HOT lanes**
- **In all concepts, the managed lanes have average travel speeds ~10 mph faster than the non-tolled lanes**

Traffic impacts: Project-level speeds

SH 71 West: Average Speeds for Tolled & Non-Tolled Lanes, 2030

	AM Peak		PM Peak	
	Tolled	Non-Tolled	Tolled	Non-Tolled
Phase 2 Plan	44	NA	44	NA
Express Lanes	45	33	44	31
Express Lanes CP	45	33	44	33
HOT Lanes	44	35	44	32
Phase 2 Roads w/ No Tolls	NA	44	NA	44

- **The Express Lane concepts provide average speeds minimally faster or the same as those for the Phase 2 Toll Plan; the HOT Lane concept provides the same average speeds as the Phase 2 Toll Plan**
- **In all concepts, the managed lanes have average travel speeds ~10 mph faster than the non-tolled lanes**

Traffic impacts: Project-level speeds

US 290 West: Average Speeds for Tolled & Non-Tolled Lanes, 2030

	AM Peak		PM Peak	
	Tolled	Non-Tolled	Tolled	Non-Tolled
Phase 2 Plan	38	NA	38	NA
Express Lanes	28	29	28	27
Express Lanes CP	28	29	27	26
HOT Lanes	30	28	29	26
Phase 2 Roads w/ No Tolls	NA	31	NA	28

- **The Phase 2 Toll Plan provides the fastest average speeds**
- **Both Express Lane concepts have a slightly slower AM average speed than the non-tolled lanes**
  - **Primarily an artifact of the average speed computation, but highlights some congestion**

Traffic impacts: Project-level speeds

US 183 South: Average Speeds for Tolled & Non-Tolled Lanes, 2030

	AM Peak		PM Peak	
	Tolled	Non-Tolled	Tolled	Non-Tolled
Phase 2 Plan	41	NA	37	NA
Express Lanes	40	32	35	28
Express Lanes CP	39	32	35	27
HOT Lanes	39	32	36	27
Phase 2 Roads w/ No Tolls	NA	34	NA	29

- **The Phase 2 Toll Plan provides average speeds 1-2 mph faster than the managed lane concepts**
- **In all concepts, the managed lanes have average travel speeds ~8 mph faster than the non-tolled lanes**

Traffic impacts: Project-level speeds

US 290 East: Average Speeds for Tolled & Non-Tolled Lanes, 2030

	AM Peak		PM Peak	
	Tolled	Non-Tolled	Tolled	Non-Tolled
Phase 2 Plan	36	NA	33	NA
Express Lanes	32	30	28	28
Express Lanes CP	33	30	28	28
HOT Lanes	36	30	31	28
Phase 2 Roads w/ No Tolls	NA	31	NA	29

- **The Phase 2 Toll Plan provides the fastest average speeds**
- **The average speed premiums of managed lanes relative to the non-tolled lanes are lower than for other projects, and disappear for some concepts in the PM peak**

Traffic impacts: Project-level speeds

Loop 360: Average Speeds for Tolled & Non-Tolled Lanes, 2030

	AM Peak		PM Peak	
	Tolled	Non-Tolled	Tolled	Non-Tolled
Phase 2 Plan	31	NA	21	NA
Express Lanes	30	24	20	17
Express Lanes CP	32	23	22	17
HOT Lanes	34	22	25	16
Phase 2 Roads w/ No Tolls	NA	25	NA	18

- **Express Lanes CP and HOT Lanes have minimally faster average speeds than the Phase 2 Toll Plan**
  - **Both of these concepts use a form of variable pricing**
- **The average speed premiums of managed lanes relative to the non-tolled lanes vary from 3 – 12 mph**

Traffic impacts: Representative travel times

Travel times in minutes from Oak Hill to City Hall, 2030

	Tolled Path	Non-Tolled Path
Phase 2 Plan	28	34
Express Lanes	27	29
Express Lanes CP	27	29
HOT Lanes	26	27

- **The next set of results compares AM peak end-to-end travel times for representative trips under the toll and managed lane concepts**
  - **Tolled path = uses a toll road or managed lane for part of trip**
  - **Non-tolled path = does not use a tolled facility at all**
  - **The non-tolled path may use completely different roads than the tolled one**
- **For this representative trip, all managed lane concepts offer shorter travel times for both the tolled and non-tolled options relative to the Phase 2 Toll Plan**

Traffic impacts: Representative travel times

Travel times in minutes from Shady Hollow to City Hall, 2030

	Tolled Path	Non-Tolled Path
Phase 2 Plan	31	35
Express Lanes	31	33
Express Lanes CP	31	33
HOT Lanes	29	32

- **The HOT Lane concept offers shorter travel times for both the tolled and non-tolled options relative to the Phase 2 Toll Plan**
- **The other concepts offer shorter travel times for only the non-tolled option**

Traffic impacts: Representative travel times

Travel times in minutes from Airport to Arboretum, 2030

	Tolled Path	Non-Tolled Path
Phase 2 Plan	28	40
Express Lanes	28	37
Express Lanes CP	28	37
HOT Lanes	28	37

- **All managed lane concepts offer shorter travel times for the non-tolled option relative to the Phase 2 Toll Plan**

Traffic impacts: Representative travel times

Travel times in minutes from Airport to Barton Creek Mall, 2030

	Tolled Path	Non-Tolled Path
Phase 2 Plan	21	27
Express Lanes	20	25
Express Lanes CP	20	25
HOT Lanes	20	26

- **All managed lane concepts offer shorter travel times for both the tolled and non-tolled options relative to the Phase 2 Toll Plan**

Traffic impacts: Representative travel times

Travel times in minutes from Manor to City Hall, 2030

	Tolled Path	Non-Tolled Path
Phase 2 Plan	33	43
Express Lanes	33	40
Express Lanes CP	32	41
HOT Lanes	32	41

- **The Express Lanes CP and HOT Lanes concepts offer shorter travel times for both the tolled and non-tolled options relative to the Phase 2 Toll Plan**
- **The Express Lanes concept offers shorter travel times for only the non-tolled option**

Traffic impacts: Representative travel times

Travel times in minutes from Arboretum to Barton Creek Mall, 2030

	Tolled Path	Non-Tolled Path
Phase 2 Plan	21	30
Express Lanes	21	29
Express Lanes CP	19	30
HOT Lanes	18	29

- **The HOT Lanes concept offers shorter travel times for both the tolled and non-tolled options relative to the Phase 2 Toll Plan**
- **The Express Lanes CP concept offers shorter travel times only for the tolled option**
- **The Express Lanes concept offers shorter travel times only for the non-tolled option**

Traffic impacts: Representative travel times

Travel times in minutes from Airport to City Hall, 2030

	Tolled Path	Non-Tolled Path
Phase 2 Plan	20	22
Express Lanes	19	21
Express Lanes CP	19	21
HOT Lanes	19	21

- **All managed lane concepts offer shorter travel times for both the tolled and non-tolled options relative to the Phase 2 Toll Plan**

Traffic impacts: Project-level traffic volumes

SH 45 Southwest: Average Traffic Volumes relative to Phase 2 toll project, and tolled vs. non-tolled shares on managed lanes projects, 2030

	AM Peak			PM Peak		
	% of Fully Tolled Volume	Tolled Share	Non-Tolled Share	% of Fully Tolled Volume	Tolled Share	Non-Tolled Share
Phase 2 Plan	100%	100%	NA	100%	100%	NA
Express Lanes	122%	13%	87%	118%	25%	75%
Express Lanes CP	124%	15%	85%	117%	24%	76%
HOT Lanes	126%	17%	83%	116%	22%	78%
Phase 2 Roads w/ No Tolls	136%	NA	100%	127%	NA	100%

- **For this and the other projects, all managed lane concepts serve more traffic volume than the corresponding Phase 2 toll project**
  - **The Phase 2 roads without tolls serve the highest traffic volume**
- **The tolled lanes' shares in the PM peak are larger than in the AM peak**

Notes: Average volumes computed as VMT divided by segment length for each project-lane combination

Traffic impacts: Project-level traffic volumes

SH 71 East: Average Traffic Volumes relative to Phase 2 toll project, and tolled vs. non-tolled shares on managed lane projects, 2030

	AM Peak			PM Peak		
	% of Fully Tolled Volume	Tolled Share	Non-Tolled Share	% of Fully Tolled Volume	Tolled Share	Non-Tolled Share
Phase 2 Plan	100%	100%	NA	100%	100%	NA
Express Lanes	138%	14%	86%	122%	24%	76%
Express Lanes CP	141%	15%	85%	121%	22%	78%
HOT Lanes	146%	19%	81%	123%	23%	77%
Phase 2 Roads w/ No Tolls	152%	NA	100%	125%	NA	100%

Notes: Average volumes computed as VMT divided by segment length for each project-lane combination

Traffic impacts: Project-level traffic volumes

SH 71 West: Average Traffic Volumes relative to Phase 2 toll project, and tolled vs. non-tolled shares on managed lane projects, 2030

	AM Peak			PM Peak		
	% of Fully Tolled Volume	Tolled Share	Non-Tolled Share	% of Fully Tolled Volume	Tolled Share	Non-Tolled Share
Phase 2 Plan	100%	100%	NA	100%	100%	NA
Express Lanes	108%	15%	85%	105%	18%	82%
Express Lanes CP	109%	15%	85%	106%	24%	76%
HOT Lanes	110%	19%	81%	105%	23%	77%
Phase 2 Roads w/ No Tolls	114%	NA	100%	111%	NA	100%

Notes: Average volumes computed as VMT divided by segment length for each project-lane combination

Traffic impacts: Project-level traffic volumes

US 290 West: Average Traffic Volumes relative to Phase 2 toll project, and tolled vs. non-tolled shares on managed lane projects, 2030

	AM Peak			PM Peak		
	% of Fully Tolled Volume	Tolled Share	Non-Tolled Share	% of Fully Tolled Volume	Tolled Share	Non-Tolled Share
Phase 2 Plan	100%	100%	NA	100%	100%	NA
Express Lanes	127%	14%	86%	128%	17%	83%
Express Lanes CP	127%	13%	87%	127%	15%	85%
HOT Lanes	127%	14%	86%	128%	15%	85%
Phase 2 Roads w/ No Tolls	129%	NA	100%	130%	NA	100%

Notes: Average volumes computed as VMT divided by segment length for each project-lane combination

Traffic impacts: Project-level traffic volumes

US 183 South: Average Traffic Volumes relative to Phase 2 toll project, and tolled vs. non-tolled shares on managed lane projects, 2030

	AM Peak			PM Peak		
	% of Fully Tolled Volume	Tolled Share	Non-Tolled Share	% of Fully Tolled Volume	Tolled Share	Non-Tolled Share
Phase 2 Plan	100%	100%	NA	100%	100%	NA
Express Lanes	151%	12%	88%	130%	24%	76%
Express Lanes CP	151%	12%	88%	129%	23%	77%
HOT Lanes	161%	18%	82%	133%	24%	76%
Phase 2 Roads w/ No Tolls	168%	NA	100%	131%	NA	100%

Notes: Average volumes computed as VMT divided by segment length for each project-lane combination

Traffic impacts: Project-level traffic volumes

US 290 East: Average Traffic Volumes relative to Phase 2 project, and tolled vs. non-tolled shares on managed lane projects, 2030

	AM Peak			PM Peak		
	% of Fully Tolled Volume	Tolled Share	Non-Tolled Share	% of Fully Tolled Volume	Tolled Share	Non-Tolled Share
Phase 2 Plan	100%	100%	NA	100%	100%	NA
Express Lanes	142%	16%	84%	139%	16%	84%
Express Lanes CP	141%	14%	86%	138%	16%	84%
HOT Lanes	144%	17%	83%	141%	17%	83%
Phase 2 Roads w/ No Tolls	153%	NA	100%	151%	NA	100%

Notes: Average volumes computed as VMT divided by segment length for each project-lane combination

Traffic impacts: Project-level traffic volumes

Loop 360: Average Traffic Volumes relative to Phase 2 toll project, and tolled vs. non-tolled shares on managed lane projects, 2030

	AM Peak			PM Peak		
	% of Fully Tolled Volume	Tolled Share	Non-Tolled Share	% of Fully Tolled Volume	Tolled Share	Non-Tolled Share
Phase 2 Plan	100%	100%	NA	100%	100%	NA
Express Lanes	111%	41%	59%	106%	46%	54%
Express Lanes CP	106%	36%	64%	104%	44%	56%
HOT Lanes	103%	33%	67%	100%	39%	61%
Phase 2 Roads w/ No Tolls	120%	NA	100%	109%	NA	100%

- **For Loop 360, the tolled lanes' shares are much higher than for the other projects**

Notes: Average volumes computed as VMT divided by segment length for each project-lane combination

Traffic impacts in 2030: Summary

- **VHT and VMT**
  - **All managed lane concepts reduce VHT relative to the Phase 2 Toll Plan, but there is little difference in VMT between concepts**
- **Speeds on Phase 2 roadways**
  - **Sometimes full toll concept is slightly faster, sometimes managed lanes are**
  - **Speeds on managed lanes average from 3-12 mph faster than parallel lanes**
- **Travel times for representative trips: tolled and non-tolled paths**
  - **Travel times for drivers who pay tolls are as good as or better with managed lanes than with full toll concepts**
  - **Travel times for drivers who don't pay tolls are often better with managed lanes than with full toll concepts**
- **Traffic volumes on Phase 2 roadways**
  - **On all roadways: no-toll volume > managed lane volume > full toll volume**
- **No managed lane concept appears clearly better than the others based on their traffic impacts**

Notes on the modeling of managed lane concepts

CAMPO Travel Demand Forecasting Model

The CAMPO travel demand forecasting model system is a conventional 4-step transportation planning model that is used to support planning analyses by forecasting various aspects of future travel. The CAMPO model system includes the following components:

- Trip Generation – process that translates socioeconomic information into trips produced from and attracted to locations, with the locations represented by Traffic Analysis Zones (TAZ);
- Trip Distribution – process that joins trip productions with trip attractions into origin-destination trips;
- Mode Choice – process that determines the mode of travel associated with each trip. In addition to the transit vs. automobile choice, CAMPO's mode choice model also predicts automobile trips by more detailed user class: single-occupant vehicles (SOV) vs. high-occupant vehicles (HOV) and tolled vs. non-tolled path for automobile trips;
- Assignment – process in which trips output from mode choice select their paths of travel and the resulting network conditions are determined. The CAMPO model includes both transit and highway assignment.

The CAMPO model includes all of the major roads in the three-county CAMPO area, as well as schematic connections to external areas. It also represents the major transit services in operation in the area. The model area is divided into XXX origin and destination TAZs, with external areas again being schematically represented.

The current arrangement for executing CAMPO's model is for TxDOT to run trip generation and trip distribution and provide those outputs to CAMPO. CAMPO then runs mode choice and assignment. The modeling staff at CAMPO provided us with the current version of the CAMPO travel demand forecasting model system necessary to run mode choice and assignment. We installed and executed the CAMPO model and, as a test of our procedures, were able to replicate the forecasts that CAMPO staff produced applying the model system to sample scenarios.

Adaptations to CAMPO Model System

The current version of the CAMPO travel demand forecasting model was not designed to support the analysis of managed lane and advanced tolling concepts.[2] In order to conduct our analysis of managed lane alternatives, we developed and applied several adaptations to the CAMPO model. These adaptations modified the model so that it better represented the travel conditions and decisions of travelers under managed lane alternatives. We developed the following five basic adaptations, described in further detail in the subsequent paragraphs:

- Moved the toll/non-toll route choice decision to highway assignment;
- Used a trip table disaggregated by trip purpose for highway assignment;
- Executed highway assignment by time of day;
- Updated values of time to match trip purposes;
- Prepared highway networks for all time periods.

[2] In fact, very few transportation forecasting model systems currently used in this country have been designed for this application.

Note that competition between transit and highway modes was recognized in the mode choice step, but that our work focused on the highway mode predictions output from the mode choice model after this competition was taken into account.

The foundation of our approach was the shift of the toll decision from the mode choice step (as currently executed in the CAMPO model) to the highway assignment step. To do this, highway assignment was altered to no longer load trips based upon minimizing travel travel time, but rather based on minimizing *generalized travel cost*. In transportation modeling, generalized travel costs are often used to represent the total impedance of travel. It generally includes time and monetary cost components, which are combined after converting one to the other using the value of time (the monetary equivalent of a unit of travel time savings, for example the dollar equivalent of an hour's travel time savings).

The current CAMPO model highway assignment component loads trips onto the network while explicitly excluding certain classes of trips from parts of the network based on the user class outputs from the mode choice step. Specifically, non-toll trips are excluded from toll facilities, and SOV trips are excluded from HOV lanes. In order to represent the toll decision in the highway assignment step, we no longer excluded *a priori* certain user classes from toll facilities; rather, we allowed each trip to determine whether it would use tolled or non-tolled routes based upon minimizing its own generalized travel cost.

To support the shift of the toll decision to the highway assignment step, we used a more disaggregate trip table in the assignment step. In the CAMPO model's mode choice step, mode and toll decisions are determined by trip purpose since traveler behavior varies by trip purpose. There are 12 trip purposes considered in the mode choice step; these are aggregated into combined trip tables for highway assignment (as noted, the CAMPO model's current highway assignment distinguishes between SOV vs. HOV and tolled vs. non-tolled trips). We established a procedure to maintain trips for all 12 trip purposes by converting intermediate person-level mode choice model outputs by trip purpose into vehicle-level trip tables; this procedure retained the SOV vs. HOV distinction, but removed the toll vs. non-toll distinction.

Another important modification was to perform separate highway assignment for different periods of the day (AM and PM peaks, off-peak), rather than a single assignment to represent an entire day. Since toll and route decisions are made based upon the generalized travel cost, of which travel time is a primary component, it is important for the model to reflect the actual travel time conditions under which those decisions are made. Travel times are typically longer in the peak periods than in the off-peak periods and, correspondingly, peak periods tend to have larger shares of toll facility usage since these are the times when toll facilities provide the largest travel time savings. The CAMPO model currently uses a daily highway assignment and also facilitates highway assignment for the two-hour AM peak period (work at CAMPO is also currently underway to model separately the PM peak period). This work has produced diurnal factors that indicate the share of daily trips that occur in the AM and PM peak periods for each trip purpose. We used these factors to convert trips from the daily level to AM and PM peak periods, with the remaining trips belonging to the off-peak period.

Depending on the purpose of their trip, different travelers hold different values of time. To enable highway assignment by trip purpose, we specified values of time by trip purpose. We categorized trip purposes into three groups: commercial trips, work trips, and non-work trips. In CAMPO's mode choice model, commercial trips have a value of time of $20.62/hour in 2006 dollars; this value is comparable to truck trip values of time presented in the literature[3] and thus we used it in our highway assignment process. For work and non-work trips, we calculated values of time based on the average wage rate of the area. A general guideline is that the value of time is somewhere in the range of 20% to 40% of the average wage rate. According to the U.S. Census Bureau, the median annual household income was $48,950 in 2000 for the Austin MSA.[4] Following the procedure specified by the U.S. Department of Transportation, this converts to an hourly wage rate of $28.75 in $2006.[5] The general guideline would then suggest a value of time between $5.75 and $11.50 / hour. We used the low end of this range as the value of time for non-work purpose trips, and the high end of the range for work purpose trips.

In order to conduct highway assignment by AM peak, PM peak, and off-peak periods, we created highway networks for each of these time periods. The CAMPO highway network contains a field that indicates if each roadway link exists only during the AM or PM peak period, or throughout the day. This field is primarily used to identify reversible HOV lanes that are only operated in one direction in the peak period, and not operated during the off-peak period. Using this field, we created networks for each time period, omitting links that do not exist for a given time period.

The CAMPO highway network also contains a peak period capacity field. Our review of the values of this field indicated that these capacity values were somewhat low for a two-hour period. Therefore, to support our peak period highway assignments, we factored the original peak period capacities up by 50%. It was important to avoid having the capacities too small in order to prevent the development of artificial congestion on the highway network that could cause some traffic to choose to use toll facilities when they would not under normal congested conditions.

We also needed to specify capacity for the off-peak period. In addition to the peak period capacities, the CAMPO highway network also contains 24-hour capacities. The 24-hour capacity values are determined through a process that factors up an hourly capacity based upon a daily use profile that varies by roadway functional class and area classification. This is a common method for creating daily capacities for highway assignment models, and it produces capacities that are smaller

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[3] U.S. Department of Transportation, Office of the Secretary of Transportation, "Revised Departmental Guidance for the Valuation of Travel Time in Economic Analysis" distributed by Memorandum February 2003, Tables 1 and 3.

[4] Census Bureau, available at http://www.ci.austin.tx.us/census/downloads/austin_msa_profile.pdf

[5] U.S. Department of Transportation, Office of the Secretary of Transportation, "Departmental Guidance for the Valuation of Travel Time in Economic Analysis." This document describes calculation of the hourly wage rate as "median annual household income, as reported by the Bureau of the Census, divided by 2,000 hours." The document also discusses how to determine the value of time from this hourly wage rate by applying factors. However, we do not recommend using the values implied by these factors as a basis for updating the model's value because of the fundamental difference in the purpose of the value of time calculation – the "Guidelines" are for benefit evaluation, while we used value of time as a behavioral predictor.

than simply factoring the hourly capacity by 24 hours. We calculated off-peak period capacities by subtracting the peak period capacities from the 24-hour capacities.[6]

Coding of Alternatives

Our analysis included the assessment of four alternatives to the Phase 2 Toll Plan, and thus we prepared a highway network corresponding to each of these alternatives; this coded highway network is a basic input to the travel forecasting model. The initial alternative was the Phase 2 Toll Plan. For this alternative, we used the CAMPO 2030 coded highway network, which already contained the Phase 2 Roads as tolled facilities. The rest of the alternative networks were derived from the Phase 2 Toll Plan highway network. For the Phase 2 Roads with no tolls, we simply removed the toll charges from the Phase 2 Plan roadway links in the coded network.

The concept of the managed lane alternatives (Express Lanes, Express Lanes CP, and HOT Lanes) is to divide the limited access freeway lanes, which are all tolled in the Phase 2 Toll Plan, into a combination of non-tolled and managed lanes; a detailed description of each managed lanes concept is given below. Our approach in defining and coding these alternatives was to convert one lane in each direction to a managed lane, and to specify the remaining limited access freeway lanes as non-tolled. To facilitate this approach, we added new links parallel to the Phase 2 Road links to represent the managed lanes, removed the tolls from the links that had previously been the Phase 2 Toll Roads, and added connector ramps between the managed lanes and non-tolled limited access freeway lanes (which in turn have connections to the frontage roads). In adding these connections, it was not our intention to address any of the engineering design issues involved in changing between the various types of lanes and the associated potential weaving patterns. Rather, we wanted to allow connections so we could determine the magnitude of managed lane usage for planning purposes. The managed lane freeway links were coded with the same free-flow speeds as the non-tolled limited access freeway lanes that they parallel. The capacities of the managed and non-tolled limited access freeway lanes were based upon their number of lanes, and were consistent with the capacity approach contained in the CAMPO model.

Toll rates coded into the network model of the Phase 2 Toll Plan were obtained from the sketch Phase 2 Plan T&R study performed by URS for the CTRMA. (The reported values were converted to equivalent values for the base year used in our study, and amount to 12¢/mi in $2006.) These rates were also applied in modeling the Express Lanes managed lanes concept. As explained below, the Express Lanes CP and HOT Lanes managed lanes concepts are intended to provide a premium service to their users, and the rates were set by running the model using different rates and choosing those that resulted in approximately level of service C conditions on the managed lanes. Toll rates resulting from this process ranged from 10¢ to 24¢/mi for Express Lanes CP, and from 10¢ to 33¢/mi for HOT lanes, in the 2030 peak periods. Off-peak rates were 2¢/mi and 4¢/mi respectively. (All values are in $2006.)

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[6] We recognize that there are two peak periods and we considered subtracting both peak period capacities from the 24-hour capacity, but chose not to implement this method because we feared that the off-peak capacities would be too low, causing too much congestion, and toll facility usage, for the off-peak period. Our method to only subtracting one peak period's capacity reflects the fact that traffic typically is heavy in opposite directions between the AM and PM peak periods for most roads.

Managed Lane Analysis Model Runs

To conduct the managed lane analysis, we used the adapted CAMPO model to perform a highway assignment using each alternative's coded highway network. As noted above, we adapted the CAMPO model to shift the toll decision into the highway assignment step and supported this shift by executing highway assignment by time of day and inputting a more disaggregate trip table. This adaptation specifies that the same trip table is used for all alternatives; this feature facilitates consistent comparisons of model results between alternatives.

We made one other adjustment when running highway assignment in order to achieve a greater level of balance within the highway network. The CAMPO model's highway assignment model uses an equilibrium assignment algorithm. Equilibrium assignment loads highway trips onto the highway network in successive iterations, with the traffic volumes from the previous iteration used to update travel times (since more traffic volume increases travel times) until a state of equilibrium or a maximum number of iterations is reached. The current CAMPO model uses a maximum of 24 iterations; we increased this parameter to 50 iterations in order to allow it to account appropriately for the close competition between tolled and non-tolled lanes on managed lanes facilities.

Analysis Details

The project's scope of work calls for an analysis of managed lane alternatives to the Phase 2 Toll Plan. Specifically, it identifies three alternatives that, in discussions with the MAFS Steering and Technical Advisory Committees, were defined as follows:

- A mixture of non-tolled lanes and managed lanes. We refer to this alternative as Express Lanes. Here we have taken managed lanes to mean lanes that can be used by any vehicle that pays a toll, where the toll is fixed and does not vary by time of day or other factor.
- A mixture of non-tolled lanes and managed lanes with congestion pricing. We refer to this alternative as Express Lanes CP (CP for Congestion Pricing). Congestion pricing refers to a situation where a vehicle pays higher charges at higher levels of congestion. While different forms of congestion pricing have been proposed and implemented, here we have taken it to mean time-of-day pricing. We implement time-of-day pricing with toll rates that differ between the peak and off-peak periods, but are fixed within each period; rates apply uniformly on a project but may vary between projects.
- A mixture of non-tolled lanes and high occupancy toll (HOT) lanes. We refer to this alternative as HOT Lanes. HOT lanes are lanes that can be used without charge by high-occupancy vehicles (HOVs) – any passenger vehicle with 2 or more occupants – while single-occupant vehicles (SOVs) can use HOT lanes if a toll is paid.

The scope of work additionally specifies consideration of shadow toll and gas tax alternatives. In both of these cases, travelers would incur no additional cost for using the Phase 2 Plan roads.[7] Accordingly, we also analyzed an alternative that

[7] We recognize that for some travelers, using the toll roads may represent a longer travel path than they would have taken otherwise, and this is accompanied by a higher fuel cost. This higher fuel cost would be further magnified in the gas tax alternative. However, for other travelers, use of the

includes the Phase 2 Plan roads provided without any tolls, which we refer to as Phase 2 Roads with No Tolls.

Analysis Results

Using the outputs of the travel demand model, we developed a number of measures that characterize the performance of the different alternatives. The following paragraphs describe specifically how model outputs were used to calculate each of the performance measures.

System level measures
Vehicle Miles Traveled (VMT) and Vehicle Hours Traveled (VHT) are two measures commonly used used to assess transportation system performance. We calculated both of these measures for each alternative by summing the total VMT and VHT for all links in the highway network except for centroid connectors.[8]

VHT is often considered the more important of the two measures, since it reflects the total time that vehicles spend traveling on the network. Since travelers often chose their routes based on travel time, they may chose a route in one alternative that has a longer distance but a shorter travel time, and this would contribute to that alternative having a higher VMT, but lower VHT.

Project-level measures
In addition to the system level performance, we present a number of performance measures at the individual project level.

Project-Level Speeds: compare the average speed for the tolled and non-tolled limited access freeway lanes for each project in each peak period. For each project-lane combination, we first calculated the VMT and VHT using all highway links associated with that combination, and then computed a volume-weighted average speed by dividing the VMT by the VHT. Note that this speed measure is different than the average speed of end-to-end travel for each project-lane combination. For the Phase 2 Plan alternative, there are no non-tolled limited access freeway lanes, and accordingly speeds are unavailable. Similarly, there are no tolled lanes in the Phase 2 Roads with No Tolls alternative.

Representative Travel Times: provide, for a set of representative trips, an indication of end-to-end travel times on tolled and non-tolled paths for each alternative. Specifically, we selected the following set of trips, with these trips designed to reflect travel on one or more of the Phase 2 Plan projects:
- Oak Hill to City Hall
- Shadow Hollow to City Hall
- Airport to Arboretum
- Airport to Barton Creek Mall
- Manor to City Hall
- Arboretum to Barton Creek Mall
- Airport to City Hall

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new toll roads would represent a more direct travel path, and their fuel costs would decrease by using these roads.

[8] Centroid connectors are links in a highway network that connect origins and destinations to the network. The lengths of centroid connectors are somewhat arbitrary, and therefore their travel distances and times are not very meaningful.

For each origin and destination, we identified the Traffic Analysis Zone to which they belong. We then used TransCAD software to determine the shortest paths of travel for the AM highway network between the selected origins and destinations. The representative travel times are for travel during the AM peak period. We define the tolled path to be the sequence of roads that provide the shortest travel time with no restrictions on whether a tolled or managed lane road is used. The non-tolled path is the sequence of roads that provide the shortest travel time while avoiding all tolled lanes. It is possible that the non-tolled path may use completely different roads than the tolled path.

Project-Level Traffic Volumes: for the AM and PM peak periods, we provide measures of the project-level traffic volumes that are associated with each alternative. For each project-lane combination, we calculated the average volume by dividing the project's total VMT[9] by its total length. We then combined each project's tolled and non-tolled lanes' volumes and compared these to the volume of the corresponding project under the Phase 2 Plan to determine the % of Fully Tolled Volume. We also determined the share of each project's total volume that uses the tolled and non-tolled lanes.

[9] Again calculating the VMT for each project-lane combination by totaling the VMT for each link in the combination.

Transportation System Benefits and Costs

Transportation user benefit/cost analysis: Framework

The cost-benefit framework includes:

- **Costs**
  - **Capital cost in the construction year (in 2006$)**
  - **Operating and maintenance costs from opening year to year 2048 (in 2006$)**
  - **Residual value of the facility in 2048, depending on number of years in service (negative cost)**
- **Transportation system user benefits**
  - **Congestion relief benefits: based on change in generalized travel cost (combination of travel time and toll costs, in 2006$)**
  - **Change in total vehicle operating costs from opening year to 2048 (in 2006$)**
  - **Change in total accident costs from opening year to 2048 (in 2006$)**
  - **These are calculated for all major roads in the three-county network, and take account of all trip components from origin to destination**
  - **Congestion on roads used to access/leave a toll or managed lane facility is recognized and incorporated in the benefit calculation**

Transportation user benefit/cost analysis: Framework (continued)

- **Construction of all the Phase 2 roadways will probably be feasible sooner with the full toll concept than with the managed lanes or no-toll concepts**
- **Because we don't know for sure how much later the managed lanes or no-toll concepts would be constructed, we did a sensitivity analysis**
  - **Managed lane projects: built either 5 or 10 years later than the full toll project**
  - **No-toll projects: built either 10 or 15 years later than the full toll project**
- **How to compare costs and benefits when they occur at different times?**
  - **Even without accounting for inflation, $1 now has a higher worth than $1 a year from now, because I can use the $1 now productively for a year**
  - **Equivalently, the *present value* of $1 received a year from now is less than $1**
  - **This is called *discounting,* and is a standard practice in project evaluation**
  - **With a 7% *discount rate*, the present value of $1 received in a future year is:**

After 5 years:	29% less	71¢
After 10 years:	49% less	51¢
After 15 years:	64% less	36¢
After 20 years:	74% less	26¢
After 40 years:	93% less	7¢

  - **The net result of discounting the *time stream* of costs and benefits over a future period is called the *net present value*, and is a standard evaluation measure**
  - **The benefit/cost ratio = PV of future benefits / PV of future costs and is another common evaluation measure**

Transportation user benefit/cost analysis: Framework (continued)

- **Stream of costs and benefits from construction year to year 2048**
- **Construction costs from the PBS&J study of March 2006**
- **Residual value in 2048 depending on number of years in service**
- **Maintenance cost estimates from earlier TxDOT / CTRMA financial feasibility studies**
- **Toll collection (system operations) costs of $0.15 / transaction**
- **Congestion reduction benefits quantified via generalized cost savings**
  - **Generalized cost based on travel time and toll payments**
  - **Value of time of $9.55 per hour (2006$), used to compute generalized cost**
- **Vehicle operating cost of $0.448 per mile (2006$) from IRS (2005), applied to change in VMT**
- **Average accident cost of $98.6 per 1,000 vehicle-miles (from NHTSA and BTS), applied to change in VMT**
- **VMT and VHT from runs of adapted CAMPO travel forecasting model applied to 2017 and 2030 conditions, and interpolated/extrapolated**
- **Economic discount rate of 7%**

Transportation user benefit/cost analysis: Results (0)

Benefit/Cost Ratio and Net Present Value: All alternatives open in 2012

	Phase 2 Toll Plan	Express Lanes	Express Lanes CP	HOT Lanes	Phase 2 Roads w/ No Tolls
Project Opening year	2012	2012	2012	2012	2012
Costs					
Present Value of Construction Costs	1,945,046	1,945,046	1,945,046	1,945,046	1,882,769
Residual Value	-79,834	-79,834	-79,834	-79,834	-77,250
Present Value of O&M Costs	347,226	152,718	172,257	158,682	102,084
Total Cost	***2,212,439***	***2,017,931***	***2,037,470***	***2,023,895***	***1,907,603***
Benefits					
Present Value of Congestion Reduction Benefits	4,322,169	5,313,051	5,294,044	5,213,327	5,708,875
Present Value of Vehicle Operating Cost Savings	815,874	795,047	787,541	774,836	739,549
Present Value of Accident Cost Savings	179,476	174,895	173,243	170,448	162,686
Total Benefits	***5,317,519***	***6,282,993***	***6,254,828***	***6,158,611***	***6,611,110***
Benefit/Cost ratio	**2.40**	**3.11**	**3.07**	**3.04**	**3.47**
Net Present Value	**3,105,080**	**4,265,062**	**4,217,359**	**4,134,716**	**4,703,507**

- **If all alternatives were able to open in 2012, the Phase 2 Plan with No Tolls would have the largest Net Present Value and the highest Benefit/Cost ratio**
  - **The Express Lanes concept would have the next highest evaluation measures**
  - **The Phase 2 Toll Plan would have the lowest evaluation measures**
- **This assumes that funding would be available to allow alternatives to open in 2012**

Note: Costs and benefits in 000 2006$

Transportation user benefit/cost analysis: Results (1)

Benefit/Cost Ratio and Net Present Value: assumes managed lane projects open in 2017 and Phase 2 Plan roads w/no tolls open in 2022

	Phase 2 Toll Plan	Express Lanes	Express Lanes CP	HOT Lanes	Phase 2 Roads w/ No Tolls
Project Opening year	2012	2017	2017	2017	2022
Costs					
Present Value of Construction Costs	1,945,046	1,386,791	1,386,791	1,386,791	957,104
Residual Value	-79,834	-103,525	-103,525	-103,525	-116,520
Present Value of O&M Costs	347,226	123,094	141,885	127,955	56,111
Total Cost	***2,212,439***	***1,406,360***	***1,425,151***	***1,411,221***	***896,696***
Benefits					
Present Value of Congestion Reduction Benefits	4,322,169	4,170,501	4,164,353	4,093,730	3,405,345
Present Value of Vehicle Operating Cost Savings	815,874	593,349	586,442	575,123	399,252
Present Value of Accident Cost Savings	179,476	130,525	129,006	126,515	87,827
Total Benefits	***5,317,519***	***4,894,374***	***4,879,800***	***4,795,368***	***3,892,424***
Benefit/Cost ratio	**2.40**	**3.48**	**3.42**	**3.40**	**4.34**
Net Present Value	**3,105,080**	**3,488,015**	**3,454,650**	**3,384,147**	**2,995,728**

- **The managed lane alternatives, and Express Lanes in particular, provide the largest net present value (NPV)**
  - **Despite opening in 2017, the managed lane alternatives produce a roughly 10% higher NPV than the Phase 2 Toll Plan opening in 2012**
- **The Phase 2 Roads w/ No Tolls have a high benefit-cost ratio because their construction costs are heavily discounted in 2022**

Note: Costs and benefits in 000 2006$

Transportation user benefit/cost analysis: Results (2)

Benefit/Cost Ratio and Net Present Value: assumes managed lane projects open in 2017 and Phase 2 Plan roads w/no tolls open in 2027

	Phase 2 Toll Plan	Express Lanes	Express Lanes CP	HOT Lanes	Phase 2 Roads w/ No Tolls
Project Opening year	2012	2017	2017	2017	2027
Costs					
Present Value of Construction Costs	1,945,046	1,386,791	1,386,791	1,386,791	682,402
Residual Value	-79,834	-103,525	-103,525	-103,525	-128,174
Present Value of O&M Costs	347,226	123,094	141,885	127,955	38,871
Total Cost	***2,212,439***	***1,406,360***	***1,425,151***	***1,411,221***	***593,099***
Benefits					
Present Value of Congestion Reduction Benefits	4,322,169	4,170,501	4,164,353	4,093,730	2,400,356
Present Value of Vehicle Operating Cost Savings	815,874	593,349	586,442	575,123	271,125
Present Value of Accident Cost Savings	179,476	130,525	129,006	126,515	59,642
Total Benefits	***5,317,519***	***4,894,374***	***4,879,800***	***4,795,368***	***2,731,124***
Benefit/Cost ratio	**2.40**	**3.48**	**3.42**	**3.40**	**4.60**
Net Present Value	**3,105,080**	**3,488,015**	**3,454,650**	**3,384,147**	**2,138,025**

- **Express Lanes provide the largest NPV**
- **The Phase 2 Roads w/ No Tolls have a high benefit-cost ratio because their construction costs are heavily discounted in 2027**

Note: Costs and benefits in 000 2006$

Transportation user benefit/cost analysis: Results (3)

Benefit/Cost Ratio and Net Present Value: assumes managed lane projects open in 2022 and Phase 2 Plan roads w/no tolls open in 2027

	Phase 2 Toll Plan	Express Lanes	Express Lanes CP	HOT Lanes	Phase 2 Roads w/ No Tolls
Project Opening year	2012	2022	2022	2022	2027
Costs					
Present Value of Construction Costs	1,945,046	988,763	988,763	988,763	682,402
Residual Value	-79,834	-120,417	-120,417	-120,417	-128,174
Present Value of O&M Costs	347,226	90,512	106,474	93,665	38,871
Total Cost	***2,212,439***	***958,858***	***974,820***	***962,011***	***593,099***
Benefits					
Present Value of Congestion Reduction Benefits	4,322,169	3,093,219	3,093,040	3,036,767	2,400,356
Present Value of Vehicle Operating Cost Savings	815,874	425,305	419,705	410,676	271,125
Present Value of Accident Cost Savings	179,476	93,559	92,327	90,341	59,642
Total Benefits	***5,317,519***	***3,612,083***	***3,605,072***	***3,537,785***	***2,731,124***
Benefit/Cost ratio	**2.40**	**3.77**	**3.70**	**3.68**	**4.60**
Net Present Value	**3,105,080**	**2,653,225**	**2,630,252**	**2,575,774**	**2,138,025**

- **The Phase 2 Toll Plan provides the largest NPV**
  - **The NPVs of the managed lane alternatives opening in 2022 are significantly lower than the NPV of the Phase 2 Toll Plan opening in 2012**
- **The Phase 2 Roads w/ No Tolls have a high benefit-cost ratio because their construction costs are heavily discounted in 2027**

Note: Costs and benefits in 000 2006$

Transportation user benefit/cost analysis: Summary

- **In a given year, the no-toll concept provides the highest level of transportation user benefits, followed by the managed lanes and then the full toll concept**
- **However, the effects of project timing on the present value of project benefits and costs need to be considered**
- **The full toll plan can probably be built before the managed lanes or no-toll concept because of its greater revenue generating capacity**
- **We did sensitivity analyses assuming that managed lanes projects are built either 5 or 10 years later, and no-toll projects either 10 or 15 years later, than the scheduled construction of the Phase 2 Toll Plan**
- **The NPVs of the managed lanes concepts built 5 years later than the Phase 2 Toll Plan projects are roughly 10% higher than that of the full toll plan**
- **A 10 year delay in the construction of the managed lanes concepts makes them non-competitive**

Notes on the benefit-cost analysis

Approach

Benefit-cost analysis is a standard approach used to evaluate transportation alternatives. We conducted a benefit-cost analysis of the Phase 2 Toll Plan and alternatives as part of our assessment. Our analysis was based on computation of the benefit/cost ratio and the net present value (NPV) of the alternatives.

We included two cost categories in our assessment: capital and operating and maintenance (O&M) costs. Capital costs are the costs associated with the construction of the Phase 2 Plan roads. We used the PBS&J construction cost estimates as the basis for capital costs for all projects except Loop 360. For Loop 360, we increased the original cost estimate from the 2004 Toll Feasibility Analysis Studies by one-third, which is the average increase in construction costs found in the PBS&J study relative to the original cost estimates. These cost estimates are in 2006 dollars. At the sketch analysis level of this study, all alternatives can be assumed to have the same construction cost.

O&M costs represent the other cost category. We calculated operating costs at $0.15 per transaction in 2006 dollars.[10] For maintenance costs, we used the project maintenance costs that were included in the 2004 Toll Feasibility Analysis Studies. These cost estimates were developed based on maintenance costs for comparable projects in the Austin district. We compared these costs with a less detailed unit cost approach and found them to be similar, and therefore decided to retain the earlier cost estimates. O&M costs occur throughout the project life and are accounted for on an annual basis.

[10] Please refer to the Assumptions of the Financial Feasibility Analysis for a discussion of how this rate was selected.

We included three categories of benefits: congestion benefits, vehicle operating cost savings, and accident cost savings. We used our 2030 travel demand forecasting results as the basis for calculating these annual benefits. We recognize that the 2030 forecasts likely overstate the level of traffic and user benefits for years prior to 2030 and understate these for years after 2030, but it was the only forecast point we had available for each alternative. To measure the benefits, we compared each alternative's travel demand model results with the results of a No Action model run. The No Action alternative represents the base case conditions in which all roads in the 2030 highway network are included except for the Phase 2 Plan Roads, which remain with their current attributes.

It is important to note that the comparison of conditions for the alternative and no-action situations takes into account the entire CAMPO model (i.e. three-county) network. Travel times, costs and distances used in these comparisons are determined for all trips made on the network, on a complete origin-destination (i.e. end-to-end basis). Thus, these comparisons and benefit calculations take into account, for example, the portions of trips made on the roads used to travel to or from a tolled facility. If, for example, these trips contribute to congestion on the non-tolled access/egress roads, this congestion will be taken into account in the benefit calculation.

We measured the annual congestion benefits of an alternative as the change in user consumer surplus with respect to the no-action base. In our travel demand modeling, trips are assigned to the highway network and choose their travel path to minimize the *generalized travel cost* between an origin and destination. In our analysis, the generalized travel cost includes both the travel time and the toll cost. Our travel demand modeling analysis used the same table of origin-destination trips for each alternative, and thus we were able to calculate the change in consumer surplus as the difference in the generalized travel cost for all trips between each alternative and the No Action model run. We calculated the total generalized travel cost of each alternative using the highway network link outputs from the forecast model runs. Specifically, we computed the total toll revenue and converted the total vehicle hours traveled (VHT) into an equivalent cost using a value of time of $9.55 per hour in 2006 dollars. This value of time represents the composite value of time for all trips, and was calculated as the average of values of time for each trip purpose weighted by the number of trips of each purpose.

The second annual benefit we considered was vehicle operating cost savings. We calculated the vehicle operating cost savings by multiplying the reduction in vehicle distance traveled by the standard IRS vehicle operating cost per mile. For each alternative, we identified the reduction in vehicle distance by subtracting its total vehicle miles traveled (VMT) from the No Action run's VMT. We used CPI to increase the IRS 2005 rate for vehicle operating cost into a rate in 2006 dollars of $0.4448 per mile.

The third annual benefit we considered was accident cost savings. We calculated this benefit in a similar manner to vehicle operating cost savings. In this case, we multiplied the reduction in VMT by an average accident cost rate. We reviewed a report by the National Highway Traffic Safety Administration that identified the total economic cost of highway motor vehicle crashes in year 2000. We then divided by the total highway VMT to identify a cost per 1,000 VMT. We then used the CPI to determine a cost of $98.60 per 1,000 VMT in 2006 dollars.

User benefits were calculated for 2017 and 2030 analysis years. Measures for the alternative and no-action situations were obtained by applying our modified CAMPO model to socio-economic data and network characteristics appropriate for those years. Using the results from these two runs, benefit values for other years were obtained by linear interpolation and extrapolation. Benefits for years beyond 2030 were capped at the 2030 value.

We used a 40-year period in our benefit-cost framework. The period began in 2009 with our assumed start of project construction. The annual stream of O&M costs and all three benefit categories began as the various Phase 2 Toll Plan projects become open to traffic. For the period between 2012 and 2015, when only some of the projects will be open, we proportioned the benefits based on the sum of the open project's share of the full plan's VMT and VHT.

To account for the fact that projects built in different years will have depreciated by different amounts at the end of the analysis period, we calculated a residual value for each project and applied it as a negative cost component in 2048. This value was calculated using a factor equal to the present value of a time stream of equal annual cost recovery factors (computed on the basis of a 50 year asset life) occurring between the end of the analysis period and the assumed end of the asset life.

While all costs were considered in 2006 dollars, we discounted future costs and benefits using a discount rate of 7%. Discounting is a standard procedure applied in cost-benefit analysis to reflect the fact that a dollar in the future is worth less than a dollar today because today's dollar could be put to immediate productive use.

For each cost and benefit category, we calculated the total values of the discounted cost and benefit stream over the 40-year period. With these values, we computed each alternative's Net Present Value (NPV) by subtracting the discounted costs from the discounted benefits. We also computed the benefit/cost ratio by dividing the discounted benefits by the discounted costs.

Sources:
National Highway Traffic Safety Administration, *The Economic Impact of Motor Vehicle Crashes*, 2000 Report No. DOT HS 809 446
Bureau of Transportation Statistics, *Transportation Statistics Annual Report*, Table 1-21b Highway Vehicle-Miles of Travel by Vehicle Type: 1993–2003

Economic Effects to the Central Texas Economy

Economic effects: Modeling framework

- To measure the economic impacts on the Central Texas economy from the construction and operation of the Phase 2 roadways,
  we used the Regional Input-Output Modeling System (RIMS II) of the U.S. Department of Commerce, Bureau of Economic Analysis (BEA)
- The RIMS model calculates impacts on:
  - Regional output ($): the change in the dollar value of production in all sectors of the regional economy to satisfy the demands from project-related spending
  - Regional earnings ($): the change in regional household earnings resulting from the production of regional goods and services to satisfy the demands from project-related spending
  - Regional employment (jobs): full time equivalent jobs created in the region as a result of project-related spending
- These impact estimates take account of
  - Direct spending in the region resulting from project construction and O&M
  - Indirect spending in the region by businesses that supply goods and services to the businesses that directly work on the projects
  - Induced spending in the region by households that receive income from jobs created by project direct and indirect spending
- Indirect and induced impacts are estimated using industry- and region-specific *multipliers* obtained from the RIMS model

Economic effects: Modeling framework - 2

- We considered the Central Texas analysis region to be the Austin-Round Rock BEA economic area, which includes the following 11 counties:

Bastrop	Llano
Blanco	Mason
Burnet	Milam
Caldwell	Travis
Hays	Williamson
Lee	

- Only expenditures/impacts in these counties are accounted for
- The estimation of the economic impacts of the Phase 2 roadways considers two distinct project phases:
  - Construction phase
  - Operations phase
- Recall that, at the level of accuracy of our study, all alternatives can be considered to have the same construction and O&M costs
  - The economic impacts calculated here apply to all alternatives
  - However, the *present value* of these impacts will vary, depending on the construction and opening years

Economic effects: Assumptions

- Construction costs are from the PBS&J study of March 2006
  - For Loop 360, the estimates of the 2004 TxDOT Toll Feasibility Analysis are used, increased by a factor of 34% to account for cost inflation
- The operating and maintenance costs are from the CRA financial feasibility analysis and the sources that it used
- Land acquisition costs are excluded from the project cost for purposes of economic impact estimation
- The impacts of the operation phase are computed over the period from opening to 2048
- Assumes the planned Phase 2 Toll Road construction and opening schedule
- The calculations and results refer to the *gross* impacts on the Central Texas economy of total construction and O&M expenditures
  - *Net* impacts will be less because not all these expenditures represent money introduced into Central Texas from outside the region
  - Some money spent on the projects will likely be diverted from other uses, with possibly different multipliers, within the region

Economic Impact: Phase II Toll Plan Gross Construction Impacts

Impact of Construction	
Construction-related spending in the Austin-Round Rock BEA Economic Area	
Total Construction Costs (2006$)	$2,689,364,334
Construction Costs Net of Land Acquisition (2006 $)	$2,487,375,461
Impact on	
Present Value of Output (2006$)	$3,638,978,580
Present Value Earnings (2006$)	$1,172,262,412
Employment (jobs)	30,062

Assumes Phase II Toll Plan construction schedule

Economic Impact: Phase II Toll Plan Gross O&M Impacts

Impacts of Operations & Maintenance between 2009 and 2048	
O&M related spending in the Austin-Round Rock BEA Economic Area	
Present Value of Total O&M costs (2006$)	$238,265,757
Impact on	
Present Value of Total Output (2006$)	$497,713,340
Present Value of Total Earnings (2006$)	$162,854,645
Total Employment (jobs)	4,295

Economic effects: Impacts of timing

- **The effects reported above assume the current Phase 2 Toll Plan opening schedule**
- **Again, the economic effects of projects that open later will have reduced present value due to effects of discounting.**

Notes on the economic effects analysis

Approach

The economic impact analysis traces spending generated by the Phase 2 Toll Plan through the economy of the Austin-Round Rock (Central Texas) economic area and measures the cumulative effects of that spending on outputs, earnings and employment. Ultimately the question is to determine how this spending impacts the economy of the Central Texas region.

Economic input-output models are commonly used to study the economic impacts of project expenditures on a specific region. Through use of regional input-output multipliers, these models capture the economic relationships and linkages between industries within a region.

Our analysis of the economic effects of the Phase 2 Toll Plan (and the alternative concepts) is based on the Regional Input-Output Modeling System (RIMS II) model of the US Department of Commerce, Bureau of Economic Analysis. RIMS II provides multipliers that reflect the industrial structure and trading patterns of specific regions in the US. RIMS II multipliers can also be compared across areas because they are based on a consistent set of estimating procedures nationwide. They are periodically updated to reflect the most recent local-area wage-and-salary and personal income data. According to empirical tests[11], economic effect estimates based on RIMS II are of a similar magnitude to estimates based on expensive custom surveys.

[11] See U.S Department of Commerce, Bureau of Economic Analysis, A User Handbook for the Regional Input-Output Modeling System (RIMS II), Third Edition, March 1997

Input-output models capture the direct, indirect and induced economic effects of project spending. Direct effects reflect the spending within the geographic analysis area on goods and services directly purchased by the project. These effects lead to growth of business sales and income in the area. However, the direct suppliers of project goods and services will in turn make purchases from their downstream suppliers, so the direct project spending ultimately has indirect effects on business activity as well. Finally, the additional business activity by direct and downstream project suppliers will provide additional income to workers and their households, so the project will have induced effects via additional household spending.

The RIMS II model provides output, earnings, and employment multipliers that are used in our analysis to trace the impacts of changes in final demand on the directly and indirectly affected industries.

We used RIMS-II multipliers specific to the BEA's eleven-county Austin-Round Rock (Central Texas) economic region. These multipliers reflect the fact that some economic impacts will occur outside of the region, an effect known as leakage. Steel, for example, may need to be purchased from other states or countries, and so most of the economic effects of steel purchases would not be felt in the Central Texas region.

Outputs

The results of the analysis are expressed in terms of three measures of economic activity:

- Output (economic activity),
- Earnings (wages and salaries), and
- Jobs

– *Output* measures the economic activity created by the project spending. It refers to the change in the total dollar value of production in all sectors of the economy in response to the demands resulting from project spending. The output measure includes goods and services. The measure of output is in the same year dollars as the measure of spending used in the calculation (2006 $ in this analysis).
– *Earnings* refers to the change in household earnings resulting from the increased production of regional goods and services in response to the project spending.
– *Jobs* refers to the number of full time person years of employment needed to meet the increased demand for regional goods and services that results from project spending.

The change in final-demand (spending in the initially affected industries) is multiplied by the respective final-demand multipliers for output, earning and employment to yield the impacts on output, earnings and employment.

It is important to note that the calculated values are *gross* impacts, and do not take account of the fact that some of the funds spent in the region on a project may in fact be diverted from alternative uses of that money in the region. Moreover, the alternative uses may have different multipliers than the considered project. Money that is spent in the region as a result of the project but that would not be spent there without the project has both gross and net impacts. On the other hand, the impacts of money that is diverted from one use in the region to another would be subtracted out of a net impact calculation. We had no way of estimating the nature and magnitude of such potential diversions, and so limited the analysis to a calculation of gross economic impacts.

Data Requirements
In order to apply the RIMS II multipliers, project expenditures must be classified with respect to each of the following traits:

– *Affected Area*: The spending location needs to be specified so that the multipliers for the appropriate region can be applied. In order to assess the economic impact of the Phase 2 Toll Plan on the Austin region, we used the regional multipliers specific to the Austin-Round Rock Economic Area. The BEA's Economic Areas define the relevant regional markets surrounding metropolitan areas. They consist of areas that serve as regional centers of economic activity, together with the surrounding counties that are economically related to these. They defined are based on commuting data, on metropolitan statistical areas as defined by the US Office of Management and Budget, and on newspaper circulation data from the Audit Bureau of Circulation. The eleven counties that make up the Austin-Round Rock Economic Area are an appropriate definition of the Central Texas economy for the MAFS analysis.
– *Industry Categories*: Spending has to be classified by spending categories consistent with the industry classification used by the BEA. Final-demand multipliers for the construction, maintenance, and repair industries were used, as well as multipliers related to the utility industry, the architectural and engineering services industry and the real estate industry. Note again that these multipliers reflect the pattern of project-generated demands, together with the structure of the firms present in the Central Texas area. If firms in the area are not able to satisfy the project demands, the multipliers reflect this leakage.

- *Project Phases*: The estimation of the impacts of the Phase 2 Toll Plan on the Austin economy is in two parts: the construction phase and the (ongoing) operations phase.
- *Year of Expenditure and Analysis Time Period*: The year of expenditure needs to be specified in order to determine the time period of the economic consequences and in order to adjust the spending to 2006 dollars. We used project construction durations provided by TxDOT, with the earliest construction occurring in 2009. The results show the present value of the impacts of construction in constant 2006 dollars. The operation phase covers a time period from the opening year to year 2048. The results show the net present value of the impacts of the spending in operation and maintenance over this time period, expressed in constant 2006 dollars.

Assumptions

- The economic discount rate used in the analysis is 7%
- Construction costs are from the PBS&J study of March 2006; except for Loop 360. For Loop 360, estimates from the TxDOT Toll Feasibility Analysis of spring 2004 are used, increased by a factor of 34%. Land acquisition costs have been excluded from the initial change in final demand.
- Construction durations and schedules are as noted above.
- The operating and maintenance costs are from the financial feasibility study

Revenue Generation

Revenue generation: Comparisons - 1

Revenue of each project as share of concept total, 2030

	Phase 2 Plan	Express Lanes	Express Lanes CP	HOT Lanes
SH45 SW	12%	7%	5%	6%
SH 71 E	15%	8%	7%	6%
SH 71 W	3%	1%	1%	1%
US 290 W	6%	2%	2%	2%
US 183 S	18%	21%	15%	12%
US 290 E	14%	9%	7%	5%
Loop 360	33%	51%	64%	68%
Total	100%	100%	100%	100%

- **Loop 360 generates the largest revenue share in all concepts**
  - **In 2030, it represents one-third of the revenue generated from the Phase 2 Toll Plan, and up to two-thirds of the revenue generated from the managed lane concepts**

Revenue generation: Comparisons - 2

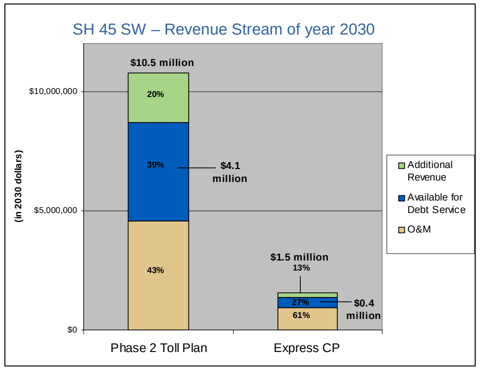
Managed lane revenue relative to full toll revenue, 2030

	Express Lanes	Express Lanes CP	HOT Lanes
SH45 SW	13%	15%	12%
SH 71 E	13%	16%	11%
SH 71 W	9%	8%	8%
US 290 W	9%	11%	10%
US 183 S	26%	27%	17%
US 290 E	14%	17%	9%
Loop 360	34%	66%	51%
Total	22%	34%	25%
Total excluding Loop 360	16%	18%	12%

- **Of the managed lane concepts, Express Lanes CP generates the most revenue**
  - **But this represents only one-third of the revenue generated from the full Phase 2 Toll Plan in 2030, and 18% in 2030 if Loop 360 is excluded**

Revenue generation: Explanation

Note: Gross revenue generation does not translate to equivalent bonding capacity



- **Example: in year 2030, the Express CP alternative generates ~15% of the Phase 2 Toll Plan's gross revenue for SH 45 SW**
- **But because of a larger portion of revenues are required to cover O&M costs, the Express CP alternative only provides ~10% of the Phase 2 Toll Plan's bonding capacity**

Revenue generation: Future Revenue Stream

We used projected annual revenues and costs in 2030 to identify the future net revenue stream that will be available to the region after retiring the bonds used to fund construction

	Future Net Revenue Stream (2006 $)	Future Net Revenue Stream w/o Loop 360 (2006 $)
Phase 2 Plan	$51,200,000	$46,500,000
Express Lanes	$8,500,000	$6,900,000
Express Lanes CP	$12,200,000	$8,100,000
HOT Lanes	$7,400,000	$4,400,000

- **The Phase 2 Toll Plan will provide a much larger future stream of revenue than any of the managed lane alternatives**

Revenue generation: Summary

- **In the most favorable situation (Express CP lanes with Loop 360 included), the managed lanes concepts produce around one-third the gross revenues of the full toll concept in 2030**
  - **If Loop 360 is excluded, Express CP lanes produce 18% of the full toll revenue**
- **However, gross revenues do not translate one-for-one into bonding capacity**
- **Bonding capacity derives from net revenues, after O&M and other costs have been subtracted from gross revenue**
- **For a sample project (SH 45 SW), the Express CP lanes produce about 15% of the full toll gross revenue in 2030, but only about 10% of the full toll bonding capacity**
- **Similarly, after construction bonds are retired, the full toll concept will generate 4-6 times as much net revenue surplus as the Express CP concept**

Financial Feasibility

Financial feasibility: Modeling framework

The financial planning analysis framework includes:

- **Annual stream of calculations**
  - **Revenues**
    - **Toll revenues**
    - **Debt service reserve fund interest**
  - **Costs**
    - **Operating costs - based on number of toll transactions**
    - **Maintenance costs – constant stream inflated to current year**
  - **Net revenues = revenues – costs**
  - **Funds available for bonding: apply debt service coverage ratio**
  - **Net Present Value of funds available for bonding - discount to year of issuance using interest rate**
- **Par value of bonds: sum of annual stream of net present value of funds available for bonding**
- **Financing costs: net out cost of issuance, underwriter's discount, and insurance premium**
- **Amount available to fund construction = par value – financing costs**

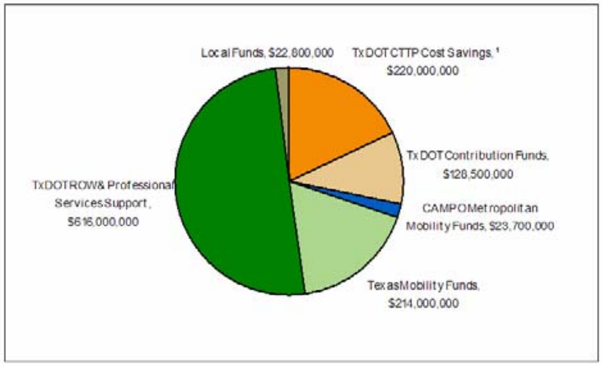
Financial feasibility: Modeling framework (continued)

Financial planning analysis framework assumptions:

- **40-year bonds**
- **Underwriter's discount of $6/$1000**
- **Issuance cost of $200,000**
- **Insurance premium of 75 basis points to obtain AAA rating**
- **Combination of Current Interest Bonds and Capital Appreciation Bonds**
  - **Use effective interest rate of 5.5% for bond sizing**
- **Debt service coverage ratio of 1.5**
- **Debt Service Reserve Fund determined as minimum of:**
  - **Maximum debt service payment**
  - **125% of average debt service payment**
  - **10% of par value**
- **Interest on Debt Service Reserve Fund of 4.5%**
- **Traffic and revenue forecasts from URS study**
  - **Traffic and revenue daily to annual conversion factor of 300**
  - **2017 and 2030 modified CAMPO model runs for managed lanes concepts factored to match URS revenues and interpolated/extrapolated to other years**
- **Maintenance cost estimates from TxDOT / CTRMA financial feasibility studies**
  - **Managed Lanes responsible for covering their own maintenance costs**
- **Operating costs calculated at $0.15 / transaction**
- **Inflation rate of 3.5% applied to operating and maintenance costs**

Financial feasibility: Available non-toll revenue funding

- **Current estimate of available Phase 2 Toll Plan funding is $1.225 billion, excluding Revenue Bond proceeds**



Source: TxDOT

Total: $1.225 Billion (2006$)

Note: Loop 360 in no longer included in the Phase 2 Toll Plan cost and funding estimates maintained by TxDOT

[1] The $220 million TxDOT CTTP Cost Savings would not be available if the roads are not built as toll roads

Financial feasibility: Results for Phase 2 Toll Plan - 1

Project-specific financial feasibility analysis of Phase 2 Toll Plan (in 000 $2006)

	SH 45 SW	SH 71 E	US 183 S	US 290W / SH 71 W	US 290 E	Loop 360[1]
Construction Costs	$74,978	$496,334	$575,002	$217,047	$584,715	$741,288
Par Value of Toll Revenue Bonds	$39,229	$147,891	$203,995	$82,389	$181,511	$60,228
Debt Service Reserve Fund	$3,923	$14,789	$20,399	$8,239	$18,151	$6,023
Financing Costs	$1,350	$4,887	$6,775	$2,876	$5,995	$2,418
Toll Revenue Bond Contribution	$33,956	$128,215	$176,821	$71,274	$157,364	$51,787
% of Construction Costs Bond Financed	45%	26%	31%	33%	27%	7%

- **SH 45 SW's toll revenue funds the largest share of its project construction costs (45%)**
- **Loop 360's toll revenue funds the smallest share of its project construction costs (7%)**

[1] Recent construction cost estimates and traffic and revenue forecasts were not available for Loop 360; values based on earlier financial feasibility analysis.

Financial feasibility: Results for Phase 2 Toll Plan - 2

Financial feasibility analysis of Phase 2 Toll Plan with and without Loop 360 (in 000 $2006)

	Full Phase 2 Plan Roads	Phase 2 Plan Roads except Loop 360
Construction Costs	($2,689,364)	($1,948,076)
Par Value of Toll Revenue Bonds	$715,242	$655,014
Debt Service Reserve Fund	$71,524	$65,501
Financing Costs	$24,301	$21,883
Toll Revenue Bond Contribution	$619,416	$567,630
% of Construction Costs Bond Financed	23%	29%
Other Funding Sources	$1,225,000	$1,225,000
Total	($844,948)	($155,447)

- **Without Loop 360, the anticipated Phase 2 Toll Plan funding approximately matches its construction costs, at this sketch level of analysis accuracy**
- **The full Phase 2 Toll Plan costs including Loop 360 are much larger than anticipated funding**

Financial feasibility results: Alternative concepts

Financial feasibility analysis of Phase 2 Toll Plan alternatives (in 000 $2006)

	Phase 2 Plan Roads	Express Lanes	Express Lanes CP	HOT Lanes	Phase 2 Roads w/o Tolls
Construction Costs	($2,689,364)	($2,689,364)	($2,689,364)	($2,689,364)	($2,602,332)
Par Value of Toll Revenue Bonds	$715,242	$106,405	$141,440	$96,549	
Debt Service Reserve Fund	$71,524	$10,640	$14,144	$9,519	
Financing Costs	$24,301	$4,669	$6,104	$4,325	
Toll Revenue Bond Contribution	$619,416	$91,095	$121,192	$82,704	
% of Construction Costs Bond Financed	23%	3%	5%	3%	0%
Other Funding Sources	$1,225,000	$1,225,000	$1,225,000	$1,225,000	$1,225,000
Total	($844,948)	($1,373,269)	($1,343,172)	($1,381,660)	($1,377,332)

- **Neither the Phase 2 Toll Plan or any of the alternative concepts can fund the corresponding concept's construction costs**
- **Toll revenue of the alternative concepts can only fund 3 – 5% of construction costs**
- **HOT Lanes fail to provide enough bonding capacity to fund the cost of its toll collection equipment (~$87 million)**

Financial feasibility results: Alternative concepts excluding Loop 360

Financial feasibility analysis of Phase 2 Toll Plan alternatives excluding Loop 360 (in 000 $2006)

	Phase 2 Plan Roads	Express Lanes	Express Lanes CP	HOT Lanes	Phase 2 Roads w/o Tolls
Construction Costs	($1,948,076)	($1,948,076)	($1,948,076)	($1,948,076)	($1,861,044)
Par Value of Toll Revenue Bonds	$655,014	$89,278	$98,698	$64,277	
Debt Service Reserve Fund	$65,501	$8,928	$9,870	$6,292	
Financing Costs	$21,883	$3,798	$4,192	$2,865	
Toll Revenue Bond Contribution	$567,630	$76,552	$84,636	$55,120	
% of Construction Costs Bond Financed	29%	4%	4%	3%	0%
Other Funding Sources	$1,225,000	$1,225,000	$1,225,000	$1,225,000	$1,225,000
Total	($155,447)	($646,524)	($638,440)	($667,956)	($636,044)

- **While funding for the Phase 2 Toll Plan is close to construction costs when Loop 360 is not included, this is not true for any of the alternative concepts**
- **No managed lane concept provides enough bonding capacity to fund the cost of its toll collection equipment (~$87 million)**

Financial feasibility: Summary

- **Bonding of toll revenues will fund around 30% of the Phase 2 Toll Plan construction costs excluding Loop 360**
  - **Revenues from Loop 360 will fund around 7% of its construction cost**
- **Without Loop 360, anticipated funding for the Phase 2 Toll Plan will approximately match the Plan's estimated construction costs**
- **If Loop 360 is included in the Toll Plan, anticipated funding is much less than estimated construction costs**
- **Bonding of toll revenues from the managed lanes concepts will fund 3-5% of estimated construction costs**

Notes on the financial feasibility analysis

Approach

In order to assess the financial feasibility of the Phase 2 Toll Plan and alternatives, we developed a financial feasibility model. We started with the framework contained in the "Toll Feasibility Analysis" studies that were completed in 2004 and posted at the time on CTRMA's website, and we updated them with more recent information while adjusting a few assumptions.

The basic financial feasibility model framework is one commonly applied for planning purposes. It begins with a 40-year annual stream of gross toll revenues. Interest earned on the Debt Service Reserve Fund is added to the gross toll revenue while annual operating and maintenance costs are netted out, with the operating costs determined on a per transaction basis and maintenance costs growing with inflation. A debt service coverage ratio is then applied to the net revenue to determine each year's bonding capacity in current dollars. The discounted present value of each year's bonding capacity is then calculated and summed to identify the total bonding capacity. From this total, the debt service reserve and financing costs (including insurance, underwriter's discount, and cost of issuance) are subtracted to identify the total bond proceeds that can be applied to construction.

New information concerning the two most basic inputs to the financial feasibility analysis has been developed since the 2004 studies. In March 2006, PBS&J developed new construction cost estimates for the Phase 2 Toll Projects, with the exception of Loop 360. These construction cost estimates reflect a greater level of detail than those prepared in 2004, as well as updated unit costs. For all projects except Loop 360, we used the PBS&J construction cost estimates in our financial feasibility study. Separately, URS developed traffic and revenue forecasts at the sketch planning level for the Phase 2 Toll Projects, again with the exception of Loop 360. These sketch level planning traffic and revenue forecasts provide two sets of forecasts: one with each toll road project assumed to open in isolation, and the other where the toll roads are opened together. The combined set of forecasts begins in 2015. We used the combined set of forecasts for years 2015 and beyond, while using the isolated set of forecasts for years prior to 2015. The sketch level planning traffic and revenue study included forecasts for the assumed 2020 opening year, and for 2030. We interpolated and extrapolated these forecasts in order to develop the schedule of toll revenues to include in the feasibility study.

As noted above, no new construction cost and toll revenue estimates were developed for Loop 360. Since the updated construction costs for the other projects were roughly one third higher than the original estimates, we increased the available Loop 360 estimates by this amount. For toll transaction and revenue, we used the first six years (through 2020) of the forecasts included in the earlier feasibility analysis. For 2021 and beyond, we grew toll revenues using a 3.5% annual growth factor, consistent with inflation rate applied to costs, and we maintained the year 2020 number of transactions into the future.

The *Sketch Level Planning Traffic and Revenue Study* includes updated estimates of project opening years. We updated the opening years in our framework while maintaining the construction duration from the earlier *Toll Feasibility Analysis*.

We updated four assumptions of the earlier studies to reflect current conditions. Specifically, we adjusted the operating cost per transaction, the discount rate, the method for sizing the Debt Service Reserve Fund, and the interest rate applied to the Debt Service Reserve Fund. We discuss these assumptions in greater detail below.

After we refined the financial feasibility model and populated it with recent data, we also used it to analyze alternatives to the Phase 2 Toll Plan. We used our 2017 and 2030 modeling results to develop revenue time streams for the alternatives considered. The factors needed to convert the model's revenue predictions to those of the *Sketch Level Planning Traffic and Revenue Study* were computed for the two years, and then linearly interpolated and extrapolated to other years. Factors for years beyond 2030 were kept at the year 2030 value. We then applied those percentages to the toll transaction and revenue forecasts contained in the *Sketch Level Planning Traffic and Revenue Study*. We also adjusted the maintenance costs to reflect the fact that the managed lane alternatives comprise only a portion of the new mainline lanes by proportioning the maintenance costs based on the managed lanes' share of new lanes.

Assumptions

As noted above, we retained many of the assumptions included in the earlier financial feasibility studies. We modified however the following four assumptions:

- Operating cost per transaction: this is the factor used to determine the annual toll system operating costs based on the annual number of toll transactions. In the original toll feasibility analysis studies, a $0.25 per transaction rate was assumed for the entire 40-year analysis period. This operating cost component incorporates a variety of operating expenses, including the electronic toll collection (ETC), associated computer systems, back-office support, administrative support, call center operations, enforcement, and maintenance of the toll collection equipment. A number of factors suggest that the actual rate may be lower. A scan of current industry experiences indicates an ETC collection cost of $0.05 - $0.10 per transaction. Concerning the other components of the cost factors, there are two reasons to believe that these costs will be lower than current experience: 1) the Phase 2 Toll Plan will develops a *system* of toll roads, which makes possible operations synergies and cost savings, and 2) the proposed system will use ETC technology exclusively, and therefore will not bear any of the costs of manual toll collection. Considering the above, we selected a cost of $0.15 / transaction for our study.
  We also assumed that the operating cost / transaction will grow at the 3.5% inflation rate applied to other cost components.
- Bond Interest Rate: This is the factor used to convert the bonding capacity from the stream of revenues in each analysis year into a present value for the year of issuance. In the original toll feasibility analysis studies, an interest rate of 6.5% was used. We reviewed the current municipal bond market and Official Statement corresponding with CTRMA's bond issuance for 183A toll road. We selected an interest rate of 5.5% to represent current bond market conditions for a likely mix of insured Current Interest Bonds and Capital Appreciation Bonds.
- Debt Service Reserve Fund: tax laws require a Debt Service Reserve Fund that is the minimum of three

conditions: 1) the maximum annual debt service payment, 2) 125% of the average annual debt service payment, or 3) 10% of the par value of the revenue bonds issued. The original toll feasibility analysis studies sized the Debt Service Reserve Fund to the maximum annual debt service payment. We found that 10% of the revenue bond par value represented the minimum of the three conditions, and therefore we applied it in our analysis.

- Debt Service Reserve Fund interest rate: this factor is used to determine the annual revenue earned on the Debt Service Reserve Fund. A 6% interest rate was applied to the Debt Service Reserve Fund in the original toll feasibility analysis studies. We reviewed current interest rates, and selected a 4.5% interest rate to represent current conditions.

Following are the assumptions that we maintained from the earlier feasibility studies:

- Annualization factor – a value of 300 is used to convert daily traffic and revenue forecasts into annual values.
- Inflation – an inflation value of 3.5% is applied to costs. Note that this is the same rate that is applied to grow toll rates in the sketch level planning traffic and revenue analysis.
- Insurance premium – an insurance premium of 75 basis points is applied to obtain an investment grade level. The insurance premium is paid at the time of issuance and applied to the entire stream of debt service payments.
- Underwritter's Discount – an Underwriter's Discount of $6 / $1000 is applied at the time of issuance on the total bond proceeds.
- Cost of issuance – a $200,000 cost is applied for each bond offering.
- Maintenance costs – for the earlier financial feasibility analysis studies, maintenance costs for each project were developed based on maintenance costs for comparable projects in the Austin district. We compared these costs with a less detailed unit cost approach and found them to be similar, and therefore decided to retain the earlier cost estimates. These costs grow annually with inflation.

Sources:

PBS&J, "Preliminary – Subject to Change, Estimated Total Project Costs", for Phase 2 Toll Plan projects, March 29, 2006

URS, "Draft, Phase 2 Corridors Sketch Level Planning Traffic and Toll Revenue Study: Base Year, Opening Year, and 2020 and 2030 Estimated Traffic and Revenue", August 24, 2006

Part 3: Summary and Conclusions

Conclusions: General

- According to the TTI, the Austin area is currently the most congested medium-sized urban area in the US
- This is in part due to a relative lack of limited access roadways in the Austin area compared to its peers
- Considering the Austin area's high forecast rates of population and automobile travel (VMT) growth, roadway capacity additions in some form are likely to be necessary to avoid significant increases in congestion levels in the future
- There are significant transportation infrastructure funding shortfalls at the national, state and local levels
- We examined, at a sketch planning level of detail, the Phase 2 Toll Plan and alternative concepts for building and operating the Phase 2 roadways, including managed lanes and non-tolled options
- These projects would represent a considerable addition to the Austin area's roadway capacity
- Implementing the projects with any of these financing and traffic management concepts would reduce the Austin area's VHT by 6-8% in 2030 compared to the Long Range Plan without these projects

Conclusions: Issues

- Time is a key issue here
- The passage of time means:
  - Construction costs escalate
  - Roadway congestion increases
  - The benefits provided by roadway improvements are deferred:
    - Transportation benefits to drivers
    - Regional economic effects resulting from construction and O&M spending
- Another key issue is the tradeoff between revenue generation and congestion management
  - Different concepts emphasize these tradeoffs in different ways
- Another key issue is financial feasibility
  - Basic financial feasibility is a necessary condition for advancing any project

Conclusions: The No-Toll Option

- Because of transportation financing constraints at the national and statewide level, it is unlikely that the complete set of Phase 2 roadways could be financed in the near term using conventional methods
- A local option gas tax increase could be used to generate additional funds that could be dedicated to transportation uses
- A fuel tax increase in the three-county area of around 5-6¢/gallon would suffice to fund the construction and maintenance of the Phase 2 roadways
- TxDOT has estimated, assuming no evasion, that a 17¢/gallon fuel tax increase in the three-county area would both fund the construction and O&M costs of the Phase 2 roadways and also generate a long-term revenue stream comparable to that of the Phase 2 Toll Plan
- The no-toll option provides the greatest congestion relief to traffic because all the added capacity is available for use by all drivers
- On the other hand, when the effects of project timing are taken into account, the transportation user benefits of this option are lowest

Conclusions: The Phase 2 Toll Plan

- We reviewed available documents about the proposed Phase 2 Toll Plan, including engineering sketch plans, preliminary cost estimates, sketch traffic and revenue studies, and preliminary financing proposals
- Based on these documents and related information from sources such as CAMPO, the Phase 2 Toll Plan appears to be a feasible way of constructing the Phase 2 roadways over the next decade or so, and of providing a substantial revenue stream thereafter
- Our update to earlier financial feasibility analyses, accounting for higher estimated costs, updated traffic and revenue forecasts, and changed financial market conditions, shows that the preliminary financing package approximately matches the total estimated plan costs excluding Loop 360
- Of the options considered, the full toll projects produce the smallest congestion relief, because some drivers will choose not to use the added capacity
- The transportation benefit-cost evaluation, considering timing, shows that the NPV of the toll plan is roughly 10% less than that of the managed lanes concepts implemented 5 years later

Conclusions: The Managed Lanes Options - 1

- **We analyzed three managed lanes concepts using a version of the CAMPO travel forecasting model that we adapted for this purpose**
- **Without Loop 360, the managed lanes concepts would generate up to 18% of the revenue of the full toll option in 2030, and up to 14% of the full toll revenue in 2017**
- **The reduction in bonding capacity corresponding to these lower revenues is more than proportional because fixed O&M and other costs subtract out proportionally more from the gross revenue of the managed lanes**
- **This implies that financing the roadways with a managed lane concept would be more difficult than with a full toll concept, and that construction of a full managed lane plan would likely be delayed compared to the full toll schedule**
  - **Construction of the managed lanes concepts may require a different financing and/or phasing strategy than that used in the Phase 2 Toll Plan**
- **On the other hand, the managed lanes options produce more congestion relief than the full toll option, because more drivers are making use of the added roadway capacity**
- **The managed lanes alternatives opening starting in 2017 produce a NPV roughly 10% higher than that of the full toll plan starting in 2012**
  - **However, greater delays would reduce the NPV of the managed lanes substantially**

Conclusions: The Managed Lanes Options - 2

- **Our analysis of managed lanes options has assumed that the projects would have the same cross-section as the full tolled alternatives, including parallel frontage roads**
- **The frontage roads add considerably to the managed lane project cost**
- **It may be possible to find alternate and less expensive ways to ensure the traffic functions that frontage roads provide, including**
  - **access to local activities**
  - **short- and medium-range mobility**
  - **connection to the limited access facility**
- **This would require a separate managed lane system planning study to examine the projects on a case-by-case basis**
  - **Traffic engineering issues on the facility**
  - **Traffic engineering issues related to frontage road replacement**
  - **Traffic and revenue forecasts**
  - **Project prioritization issues**
  - **Financial feasibility analysis**
- **The results of such a study, of course, cannot be determined in advance**

APPENDICES

Tolling Glossary

Tolling glossary - 1

Road pricing: any method that charges road users for their use of roads

Variable toll: one that varies by fixed time of day (eg peak/off-peak period)

Congestion pricing: toll (or other payment) depends on level of congestion

Value pricing: a form of congestion pricing in which toll is set at a level to provide a specific level of service to users (typically near free flow)

Managed lanes: general term for specific lanes of a roadway that are restricted for use by certain vehicles, and actively managed

- **HOV lanes: for use only by high occupancy vehicles: cars with 2+ or 3+ occupants, transit, taxis; possibly low-emissions vehicles; may be separated from regular lanes**
- **HOT lanes: HOV lanes that allow access to otherwise non-eligible vehicles if they pay a toll (which may vary by level of congestion)**
- **TOT lanes (or roads): tolled lanes (roads) for exclusive use by trucks; use may be optional or mandatory**
- **Express lanes: specific lanes that are managed to provide premium service compared to the other lanes of a roadway**
- **FAIR lanes: separated lanes that are free to HOV, transit and paratransit vehicles, and value priced for others. Users of regular lanes receive credit for use of FAIR lanes or transit**

Tolling glossary - 2

Credit-based value pricing: Road users receive an allocation of credits in a period. A trip uses a number of credits depending on its characteristics. Unused credits can be sold. Additional credits can be bought.

Revenue neutral (or minimum revenue) road pricing: some users pay while others receive credits based on road use; low net revenue generation

Distance-based road pricing: payment is based on total distance driven anywhere on the road network (not just on specific roads); payment may also depend on vehicle characteristics (weight, emissions)

Variabilize: convert a fixed cost of auto ownership (purchase tax, registration, insurance) into a cost that varies with the amount of auto use

- **Pay as you drive (PAYD) insurance: auto insurance premium depends on annual amount driven**

Shadow tolls: a private road builder/operator receives from the government a payment that depends on the amount of traffic using the road, *as if* the road users were actually paying a toll

Open road tolling: tolls are collected without use of barriers or toll booths, allowing high-capacity operation across multiple lanes

Peer Reference: Case Studies

Peer Reference: Case Studies

IH 10 Katy Freeway QuickRide – Houston, TX, 1998

- **Involved Parties: TxDOT, Houston Metro,**
- **Funding Highlights: Funded as an FHWA Priority Corridor value pricing pilot program**
- **Toll Rate Controls: Houston Metro, part of Harris County government, decides tolls**
- **Travel Demand Management Highlights: converting from HOV to HOT has increased use of HOV lanes**
- **Additional Notes: This successful program will be expanded to other freeways in the region, including the Northwest Freeway**

Peer Reference: Case Studies

Pocahontas Parkway 1 – Richmond, VA, opened 2002

- **Involved Parties: Virginia DOT, Fluor Corp, Washington Group International, Pocahontas Parkway Association (PPA)**
- **Funding Highlights:**
  - **$9 million federal funds for design costs**
  - **$354 million tax exempt toll revenue bonds sold by 63-20 corporation, $18 million in SIB loans**
- **Financing Highlights: Non-profit 63-20 corporation formed to issue tax-exempt debt**
- **Additional Notes: Construction costs above estimates, and traffic and revenue below forecasts resulted in project revenues only covering less than half of annual debt service**

Peer Reference: Case Studies

Pocahontas Parkway 2 – Richmond, VA, transaction pending 2006

- **Involved Parties: Virginia DOT, Transurban, Depfa Bank (Ireland)**
- **Funding Highlights:**
  - **Equity: Transurban $131 million at close; up to $55 million more possible**
  - **Debt : Depfa $487 million**
- **Financing Highlights: "Permit Fee" provides Virginia with 40% of gross revenues after net cash flow provides project IRR of 6.5%; 80% after IRR of 8.0%**
- **Toll Rate Controls:**
  - **Six steps to increase from $1.50 to $4.00 by 2016**
  - **Subsequent rate increases based on highest of regional GDP, CPI, or 2.8%**

Peer Reference: Case Studies

Indiana East-West Toll Road I-90 – Indiana, to be privatized 2006

- **Involved Parties:** State of Indiana, Cintra Concesiones de Infraestructuras de Transporte, Macquarie Group
- **Funding Highlights:** Cintra and Macquarie paid $3.8 billion for the 75-year concession rights to upgrade, maintain and operate road in return for toll revenues
- **Toll Rate Controls:** car tolls restricted to rate of inflation, short distance truck tolls can increase moderately, long distance truck tolls can increase considerably
- **Additional Notes:** This has been a very controversial decision in Indiana; this transaction does not enjoy the broad support of the Chicago Skyway concession despite a shorter duration (75 vs. 99 years) and larger concession fee ($3.8 vs. $1.8 billion)

Peer Reference: Case Studies

Chicago Skyway Bridge – Chicago, IL, privatized 2005

- **Involved Parties:** City of Chicago, Skyway Concession Company, LLC (SCC)
- **Funding Highlights:** Cintra and Macquarie paid $1.83 billion for the 99-year concession rights to upgrade, maintain and operate in return for toll revenues
- **Toll Rate Controls:** limits on tolls for passenger vehicles are specified through 2017, with later adjustments indexed to different inflation indicators

Peer Reference: Case Studies

I-81 Corridor – Virginia, improvements considered for near future

- **Involved Parties:** Virginia DOT, Star Solutions
- **Funding Highlights:** VDOT is still in negotiations with Star Solutions
- **Travel Demand Management Highlights:** Star Solutions is proposing Truck-Only Toll lanes to add capacity to I-81, but details are still under negotiation

Peer Reference: Case Studies

I-15 FasTrak – San Diego, CA, converted from HOV to HOT Lanes in 1999

- **Involved Parties:** San Diego Association of Governments (SANDAG), Federal Highway Administration (FHWA), Federal Transit Administration (FTA)
- **Funding Highlights:** $8 million FHWA (ISTEA), $2 million SANDAG, $230 thousand FTA
- **Financing Highlights:** FasTrak toll revenues pay for $750 thousand per year in operating costs, $60 thousand for law enforcement, and funds the express bus service annually.
- **Toll Rate Controls:** controlled by SANDAG
- **Travel Demand Management Highlights:** HOT lane has increased both number of carpools and use of lanes by more than 100%
- **Additional Notes:** project has received very positive public feedback

Peer Reference: Case Studies

South Bay Expressway SR-125 – San Diego, CA, opening 2007

- **Involved Parties:** State of California, California Transportation Ventures, Incorporated (CTV), San Diego Association of Governments (SANDAG), California Transportation Commission (CTC), USDOT, City of Chula Vista, Otay River Constructors
- **Funding Highlights:**
  - Equity: area developers contributed $48 million right of way, SANDAG $138 million, additional funding CTC and CTV
  - Debt : TIFIA $140 million, additional bank loans
- **Financing Highlights:** Maximum 18.5% ROI allowed with additional allowed incentive return for increased average vehicle occupancy on the toll road.
- **Toll Rate Controls:** Tolls schedule not yet published; developer able to set market rate tolls

Peer Reference: Case Studies

SR 91 Express Lanes – Orange County, CA, 1995

- **Involved Parties:** Caltrans, Orange County Transportation Authority (OCTA), California Private Transportation Company (CPTC)
- **Funding Highlights:**
  - Equity: $20 million private equity,
  - Debt : $65 million in 14-year variable rate bank loans, $35 million longer term loans, $9 million subordinated debt to OCTA
- **Toll Rate Controls:** State now owns lanes, sets variable rate toll schedule.
- **Travel Demand Management Highlights:** Variable rate Express Lanes to maintain free flow travel time
- **Additional Notes:** OCTA purchased the toll road from CPTC in April 2002 in order to construct a parallel facility that was prohibited in the original contract's non-compete clause

Peer Reference: Case Studies

Transportation Corridor Agencies – Orange County CA

- The Foothill/Eastern and San Joaquin Hills Transportation Corridor Agencies are two joint powers authorities that planned, financed, constructed, and now operate 51-miles of toll roads in Orange County CA
  - Joint powers authorities are a California creation that allows two or more public agencies to join together to provide more effective services at reduced cost
  - Combined, TCA operates 4 toll roads: state roads 73, 133, 241, and 261
- A toll road system provides synergies:
  - In return for support and permission to construct a 16-mile extension, one of the agencies will make payments to the other agency to compensate for lost traffic revenue during construction
  - One agency will provide a loan to the other to improve its debt coverage

Peer Reference: Case Studies

Florida Turnpike Enterprise

- Created in 2002 as a business unit within Florida DOT
- Inherited 320 miles of existing toll roads in five different systems
- Since then, it has added 129 miles to the system (106 miles of new construction), and has upgraded the older systems
- In 2005, the Enterprise generated approx. $600M in revenue
- Most of this has been used for system upgrades and expansions
- The FTE bond rating was recently upgraded

Responses of Texas MPOs to the Funding Situation

Responses of Texas MPOs to the funding situation

We also talked to most of the Texas MPOs to get information about their general approach to dealing with the transportation funding situation

- Corpus Christi
- Dallas/Fort Worth
- El Paso
- Hidalgo
- Houston/Galveston
- Lubbock
- San Antonio

Response of other Texas MPOs: Corpus Christi

- Consideration of tolling options is in a very preliminary state
- An RMA has not been formed
- Possible projects include adding managed lanes to existing roadways, and adding tolls to the existing harbor bridge
- Other transportation financing mechanisms being considered include:
  - A general tariff on ship cargo
  - A charge on ships based on size

Response of other Texas MPOs: El Paso

- There are currently three toll facilities in the metropolitan area: the international bridges
  - Toll revenues from two of the bridges go to the City of El Paso, but are not dedicated to transportation uses (except for bridge works)
- The public has a general concern about congestion increases and about lack of relief routes for Interstate 10
- Two possible relief routes (the Northeast Parkway and Southern Relief Route) are currently being compared by the MPO and TxDOT
- The selected route could be developed as a toll road
  - Unbuilt sections of the Northeast Parkway are currently in the Long Range Plan as a tollway
- Creation of an RMA is under consideration, but is complicated by the proximity to New Mexico
- El Paso is looking at possibility of generating transportation funds through a sales tax increase, but the smaller urban areas in the MPO are at their tax ceiling (and would generate only limited funds)

Response of other Texas MPOs: Hidalgo

- **Two toll projects are currently included in the Long Range Plan**
  - **A Pharr Connector linking the Pharr Bridge to US83 and relieving US281, which goes through downtown Pharr**
  - **A West County-La Joya Loop that serves as a bypass to US83**
- **Public opposition to the Pharr Connector has put development on hold, although it has not been removed from the LRP**
- **Public reaction to the La Joya Loop has been mixed, but the project is currently on hold pending further study of bonding feasibility**
- **An RMA has just been formed and is looking at the feasibility of a Hidalgo County Loop; the cost appears high compared to traffic**
- **Non-toll transportation funding options are also being examined**
  - **A toll increase at the Pharr Bridge, with proceeds going to a Mobility Fund**
  - **A ¼¢ sales tax increase, with proceeds going to Mobility Fund, estimated to produce $500 million over 25 years**

Response of other Texas MPOs: Houston / Galveston

- **There are already several toll roads in operation**
- **Most current tolling proposals are for the addition of managed lanes to existing roads**
  - **In some cases, the toll road authority provides funding to TxDOT to construct the managed lanes, and then assumes responsibility for operating them**
- **At least one proposal involves conversion of HOV lanes to HOT lanes with some form of congestion pricing**
- **People generally accept development of new roads as toll roads, but react against proposals to convert existing roads from non-toll to toll**

Toll Plans of Other Texas MPOs: San Antonio

- **The 2005 update to the Long Range Plan included several managed lanes projects that would add capacity to existing roadways**
- **The MPO Board unanimously adopted the LRP, but there was some public opposition to toll proposals**
- **A detailed policy regarding development of toll projects has not yet been determined**
- **To date, potential toll projects are identified by MPO and TxDOT working closely, identifying candidate segments and forecasting potential traffic and revenue**
- **The Alamo RMA was created in 2003**
- **Several projects are under consideration for development by Comprehensive Development Agreements (CDAs)**
- **Since 2004 a ¼¢ dedicated sales tax produces about $34 million/year for transportation improvements**
  - **50% for transit**
  - **25% for TxDOT projects**
  - **25% for City road improvement projects**