

Effect of MTC Express Lanes on Interregional Travel

Report

prepared for

Metropolitan Transportation Commission

prepared by

Cambridge Systematics, Inc.

report

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date

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1.0 Introduction

Bay Area transportation agencies are developing a 550-mile network of Express Lanes that will allow solo drivers or carpool vehicles not meeting the occupancy requirements to pay a toll to use the carpool lane for a faster and more reliable trip. Lanes are already open on I-580 through Dublin, Pleasanton, and Livermore; on southbound I-680 from Pleasanton to Milpitas; and on State Route 237 between Milpitas and San Jose.

The purpose of this study is to evaluate the impact of new express lanes (also known as high occupancy toll, or HOT lanes) on interregional traffic. As part of this study, a literature review was undertaken to examine the degree to which interregional traffic has been studied for proposed express lanes throughout the United States. Following the literature review, various models in the Bay Area were evaluated to assess their capability to best capture the relationship between interregional travel and express lanes. Once the model to be used in this study was selected and run, the change in interregional trips resulting from the addition of express lanes was evaluated.

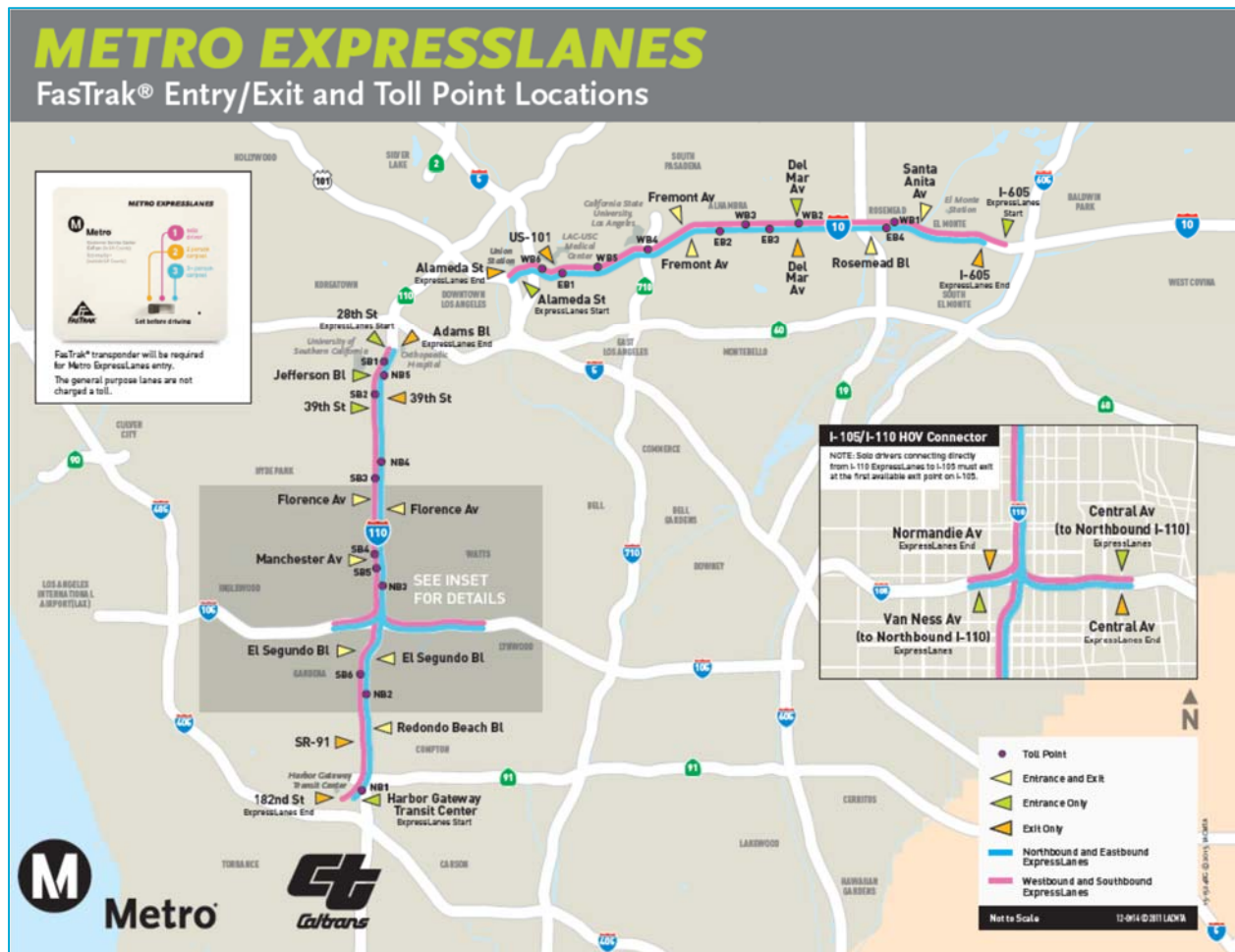
2.0 Literature Review

Different regions in the United States have evaluated and implemented regional express and managed lane systems. These systems have distinct network configurations, spatial and temporal variations in demand and road-user characteristics. These differences govern a region's response to express lanes and thereby predict/determine the actual nature of traffic and express lane usage. The review of existing and proposed express lanes assessed whether the express lane study extent was part of a larger network of express lanes and whether interregional travel was evaluated, as well as examined the modeling methodology.

Proposed and existing express lane systems for areas comparable to the San Francisco Bay Area were selected for evaluation. Key screening considerations were for urban areas sufficiently large in population, and having potentially significant interregional commuting patterns. As a result, the analysis of other regions focused on the Washington DC area, as well as Florida and Texas. Reviews of other California regions were also conducted, with San Diego and San Joaquin County studies being most relevant. For most of these studies, interregional analyses were not conducted during project planning and environmental assessment for some key reasons: the express lane facilities tend to be situated within the central parts of each region (not at the regional edges), and limited modeling tools were available for assessing interregional travel.

Additional inquiries were made for a number of other regions. The Southern California Association of Governments (SCAG) region, for example has notably implemented express lanes on the I-10 and I-110, and may generally be comparable to the MTC Region. See Figure 1 for a map of the existing Los Angeles County express lanes. However, due to the location of Los Angeles County at the center of the SCAG region (over five times the size of the MTC Region), and the location of these express lane facilities (far from SCAG regional boundaries), interregional travel was not documented during the planning phases for these facilities. As such, express lanes within the SCAG Region were not summarized for the purposes of this memorandum. Summaries are presented here for a representative sub-set of regional studies.

Figure 1. Existing SCAG Region Express Lanes



SOURCE: LOS ANGELES METROPOLITAN PLANNING AGENCY.

Table 1 summarizes findings from a representative selection of express lane planning and environmental studies throughout the United States. As noted above, most regional express lane analyses did not evaluate interregional travel. Modeling tools varied significantly depending on the ability to evaluate tolling on managed lanes directly within the regional or statewide model system. We have summarized only the study regions that have an extensive network of express lanes, and have undertaken significant efforts to study their feasibility and effects on travel demand management. Table 1 also notes other study areas that have not been summarized in this memorandum because they were determined not to be applicable for this analysis. The comment 'interregional travel not assessed' is noted for a number of studies; Interregional travel may have been included in the travel demand modeling in some form; however, available documentation omitted mention of interregional travel.

Table 1. Literature Review Findings

Study Region	Agency	Specific assessment of Interregional travel?	Methodology
Studies Summarized in Body of Memorandum			
Metropolitan Washington D.C.	Metropolitan Washington Council of Governments	No	External toll-update algorithm to evaluate demand for toll and express lanes.
Northern Virginia I-66 corridor	Virginia Department of Transportation & Metropolitan Washington Council of Governments	No	Select-link analysis during traffic assignment to determine travel markets passing through I-66 corridor.
State of Florida	Florida Department of Transportation, Turnpike Toll Authority	No	Customized travel demand models for regional applications, e.g. 10-county region Cent. Florida Turnpike Model.
I-580 Corridor Study	San Joaquin Council of Governments, Alameda County Transportation Commission	Yes	Select link-analysis from SJCOG and ACTC models are combined to study interregional travel on I-580. Express lanes not evaluated.
San Diego County I-15	San Diego Association of Governments	Yes	External travel model that predicts characteristics of vehicle trips and location. Toll choice model applied internal and interregional vehicle trips.
Additional Studies			
Los Angeles County I-10 and I-110 Corridors	Los Angeles Metropolitan Transportation Agency	No	SCAG Model tolling applications within mode choice and traffic assignment. Interregional travel not assessed.
Houston Metropolitan Area	Harris County Toll Authority and Houston-Galveston Area Council	No	Corridor-level analyses of toll and express lanes to determine project feasibility. Interregional travel not assessed.
Chicago Area	Illinois Department of Transportation and Illinois Tollway Authority	No	Toll and no-toll trips are assigned to highway network to determine demand. Interregional travel not assessed.
Minneapolis I-394 Corridor	Minnesota Department of Transportation	No	Mode choice model modified with new parameters to allow estimation of trips by tolled single-occupancy vehicles. Interregional travel not assessed.
Portland I-205 and SR-212 corridors	Oregon Department of Transportation	No	O-D survey, with direct demand generation and route choice assignment. Interregional travel not assessed.
Seattle I-5 Express Lanes Toll Study	Washington Department of Transportation	No	Corridor-level analysis using Washington State Transportation Commission (WSTC) 4-step model. Interregional travel not assessed.

Study Region	Agency	Specific assessment of Interregional travel?	Methodology
Seattle I-405 Corridor Study	Washington Department of Transportation	No	Corridor-level analysis using WSTC model. Sated preference survey data used to update value of time and willingness-to-pay for proposed express lanes. Interregional travel not assessed.
US-101 Sonoma County	Sonoma County Transportation Authority, MTC	No	Corridor level analysis using the 4-step MTC travel model. Interregional travel not assessed.

2.1 Sample Case Studies

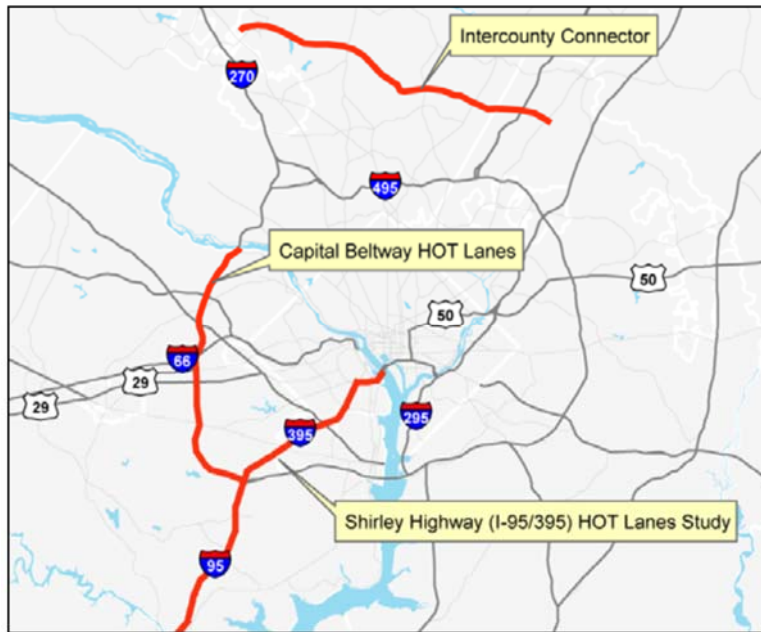
With continuing growth in travel demand and worsening congestion, a number of planning agencies have initiated projects that rely on tolling for congestion management. Case studies for larger metropolitan areas that have successfully identified and studied the feasibility of using the concepts of managed lanes that include express lanes are discussed in the following sections. Note that case-studies have been organized by their geographical location, generally from east to west.

2.1.1 Metropolitan Washington Council of Governments

The Metropolitan Washington Council of Governments (MWCOC) evaluated a regional network of variably priced highway lanes. Three major variably priced highway facilities were evaluated as shown in Figure 2. These included the Inter County Connector in Suburban Maryland, the Northern Virginia Capital Beltway and I-95/395 high occupancy toll (HOT) lanes projects.

- The Inter-County Connector is an 18-mile east-west highway in Montgomery and Prince George's counties in Maryland that will run between I-270 & I-95/US 1;
- The Northern Virginia Capital Beltway (I-495) project will add four new HOT lanes to a 14-mile segment. Vehicles with three or more occupants, as well as transit buses and emergency response vehicles will use the lanes for free; all other vehicles will pay a toll that varies by levels of congestion and time of day; and
- The 36-mile I-95/395 HOT lane project in Virginia will reconfigure the existing HOV facility in Arlington County from 2 lanes to 3 lanes and convert those lanes to HOT lanes.

Figure 2. Value pricing projects in Metropolitan Washington Area



SOURCE: METROPOLITAN WASHINGTON COUNCIL OF GOVERNMENTS

The regional travel demand model was utilized to forecast transportation demand and performance characteristics for the Year 2030. A toll update algorithm (applied outside of the regional model system) evaluated the demand for toll and HOT lanes. When these roadways showed congestion, the tolls were raised and then demand was re-assigned. This process continued until the toll lanes were “relatively free flowing”, as determined by volume-to-capacity ratios. Finally, the toll rates were updated in the travel demand model as determined by the toll update algorithm. The four-step model was rerun to reflect these impacts of tolls on trip distribution, route choice and mode choice.

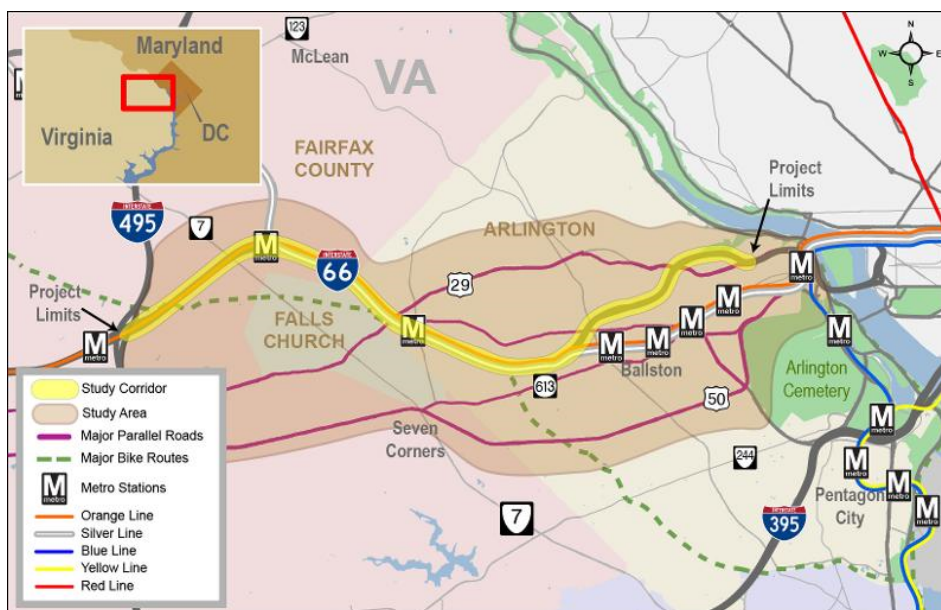
The tolls were incorporated into the model as equivalent minutes of travel time using the travelers’ value of time. The results of the analysis demonstrated that toll rates on variably priced lanes in the regional networks would have to vary significantly by segment, direction and time-of-day to maintain free-flowing conditions. Toll rates ranged from \$0.20 per mile to over \$2.00 per mile. Additionally, the MWCOG study showed that extensive transit service on the value priced lanes network increased systemwide transit use by around 4%, and decreased high occupancy vehicles (HOV) use between 4% and 15%. The feasibility study was focused on regional travel patterns, with specific emphasis on corridor-level analysis in the suburban areas of Maryland and Virginia. Interregional travel was not assessed as part of this study.

2.1.2 Virginia Department of Transportation I-66 Corridor Study

The Virginia Department of Transportation (VDOT) conducted an I-66 dynamically priced high-occupancy toll lanes feasibility study from I-495 (Capital Beltway) to US 29 (Lee Highway) in Arlington County. Figure 3 shows the I-66 HOT lane corridor (VDOT 2012).

The MWCOG regional travel demand model was used to study the potential demand and revenue for the I-66 Beltway Corridor. The MWCOG model was refined significantly by disaggregating corridor travel analysis zones, refining the roadway network system along with provisions for park and ride facilities and representing transit improvements in the region. The improvements in the regional MWCOG travel model were further validated based on traffic counts conducted for vehicles traveling eastbound and westbound along the I-66 corridor for a typical weekday. The validated model was used to conduct select link analyses for potential toll lanes. Trips from external stations were included in the select link analyses, but did not have a significant impact on I-66 corridor travel. Overall, the analysis was constrained to MWCOG intra-regional travel patterns and inter-regional travel was not evaluated.

Figure 3. I-66 Northern Virginia HOT Lane Study Area



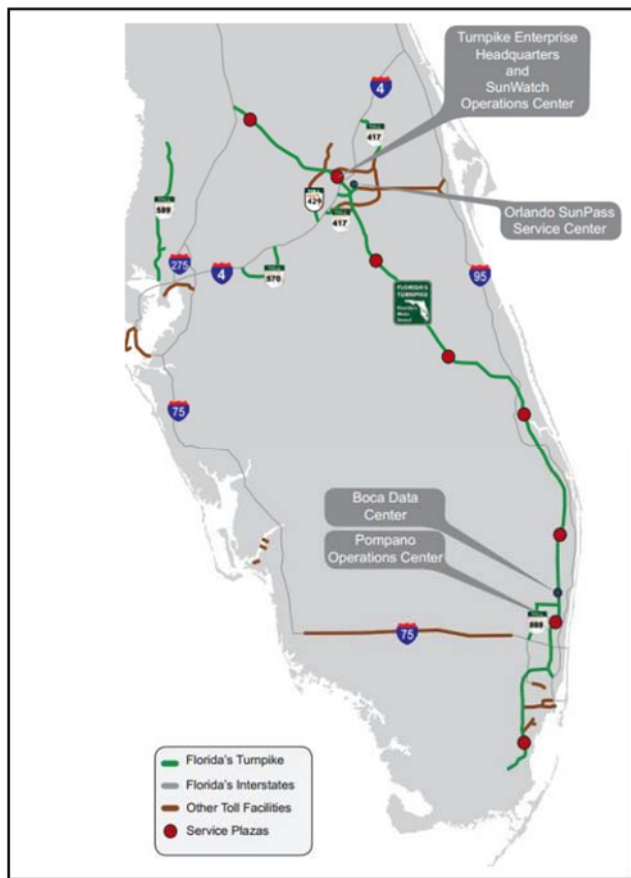
SOURCE: VIRGINIA DEPARTMENT OF TRANSPORTATION

2.1.3 Florida Department of Transportation (FDOT) Managed Lanes

The Florida Department of Transportation (FDOT) has conducted various travel demand modeling efforts to study express lane projects. Each successive effort typically includes enhancements to the latest version of the MPO regional travel demand model. For instance, in the case of I-95 express lane study, a 3-phased approach was adopted to study implications of express/toll lanes on regional travel patterns of the Miami metropolitan area (FDOT 2013). In the first phase, analysis of demand for I-95 express lanes was performed using traditional tolling parameters with the standard 4-step assignment process. In the second phase, a binary logit choice model was implemented to allow for tolled route and non-tolled route choices during the highway assignment. Finally, in the third phase retaining the binary choice model in assignment process, the model parameters were refined to increase sensitivity to changes in tolls and travel times. FDOT managed lanes analyses have focused solely on intraregional travel within the Miami metropolitan area.

In contrast, the Florida State Turnpike Authority that oversees toll road facilities in the 10-county region of Central Florida, used their own travel demand model, Turnpike Central Florida Model (TCFM), for specifically evaluating express and toll roads in the region. The toll road system is shown in Figure 4. The TCFM is a customized travel demand modeling tool developed specifically to forecast toll/express traffic and more precisely simulate users' decisions under various travel demand management strategies. FDOT also uses their statewide model to evaluate express/managed lanes projects, such as the I-4 traffic and revenue study in Orlando. However, most of the travel and revenue studies undertaken in Florida do not account for interregional travel as part of their modeling strategy. Instead, external traffic was considered as an input at the external gateways (Florida Turnpike Enterprise 2011).

Figure 4. Florida Turnpike Toll Roads System Map



SOURCE: FLORIDA TURNPIKE ENTERPRISE

2.1.4 I-580 Interregional Multi-Modal Corridor Study

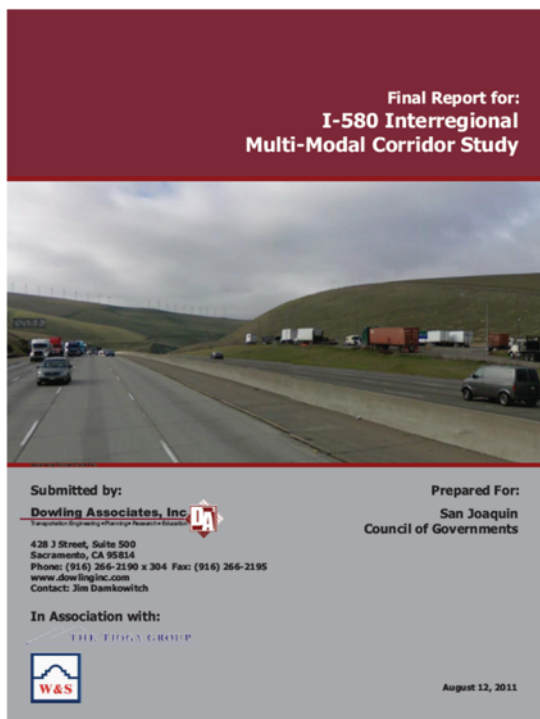
In 2010, the San Joaquin Council of Governments (SJCOG) in conjunction with Caltrans commissioned a study to improve the productivity and efficient utilization of corridor transportation facilities by commuters and commercial trucking on I-580 (SJCOG 2011). The interregional multimodal corridor analysis

examined various strategies with a focus on transportation demand management, goods movement and transit services.

Express lanes were noted in I-580 corridor study, but not specifically analyzed. This study was reviewed due to its use of the SJCOG and Alameda Transportation Commission (ACTC) travel demand models to study interregional transportation improvement strategies along the I-580 corridor. Both models (as used at the time of the study) included Alameda and San Joaquin Counties, so analyses of interregional travel across the Altamont Pass (and other routes connecting the San Joaquin Valley with the San Francisco Bay Area) could be conducted directly within the model system. This additional coverage – beyond the nine county San Francisco Bay Area – provides an analytical advantage over the MTC Model coverage area that extends only to the Alameda County border near the Altamont Pass.

Select-link analyses were used to identify trip origins and destinations (OD) by county as a percentage of total trips traveling along the I-580 corridor. Furthermore, both the models also accounted for the impact of interregional traffic on network congestion based on OD travel times and the routes chosen during traffic assignment.

Figure 5. I-580 Multi-Modal Study Corridor Study



SOURCE: SAN JOAQUIN COUNCIL OF GOVERNMENTS

2.1.5 San Diego County I-15 Interregional Partnership

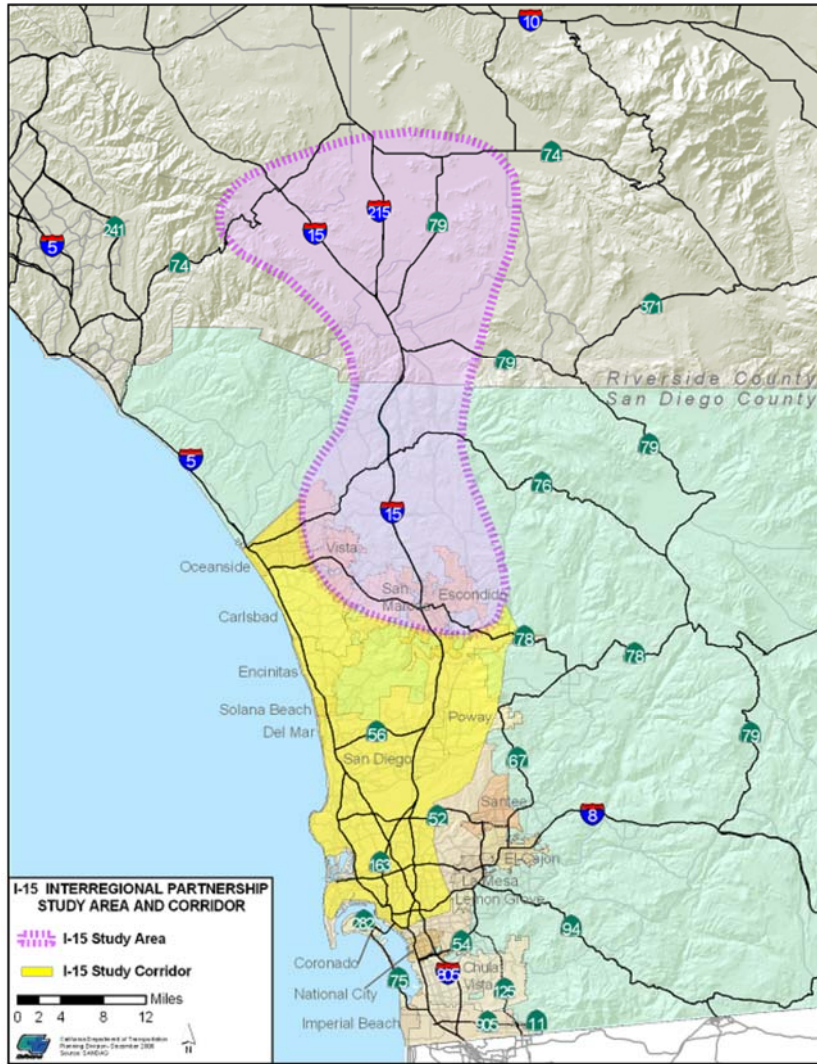
More than 30,000 people live in Riverside County and commute to San Diego County for work, many traveling for more than two hours each day. Of these interregional commuters, more than 85% travel

alone. The I-15 Interregional Partnership (IRP) was formed to address the issue related to the spatial mismatch of jobs and housing. The San Diego Association of Governments (SANDAG), Western Riverside Council of Governments (WRCOG) and Riverside County Transportation Commission (RCTC) along with Caltrans are its member agencies. Figure 6 illustrates the I-15 IRP study area and corridor in Southern California.

SANDAG conducted two data collection efforts in 2002 and 2006 to understand interregional travel patterns and traveler behaviors. These data collection efforts were considered central in helping design better transportation policy analysis tools, particularly for addressing value pricing strategies along the I-15 corridor. As part of evaluating pricing strategies, SANDAG designed an external travel model, which predicts characteristics of all vehicle trips and selected transit trips crossing the San Diego County border. The external travel model is segmented by different trip types e.g. external-external, external-internal and internal-external. The external locations outside of San Diego County consist of both the Mexican border and other gateways to the San Diego Region.

Data from the 2006 Interregional Travel Survey was specifically used to build a model to predict the destination choice of trips to San Diego from surrounding counties. As part of the model design, external-internal trips were further split into toll and no-toll route choices for work and non-work trips based on factors related to travel and time and toll cost. In addition, these trips were further subject to mode split after choosing the destination choice for each of the trip segment types (internal-external, external-internal and external-external). The current SANDAG external travel model is also being validated using cellphone data.

Figure 6. I-15 Interregional Partnership Study Area



SOURCE: SAN DIEGO ASSOCIATION OF GOVERNMENTS

2.2 Summary

Continued growth in travel demand, worsening congestion and rapid land-development in both urban cores and suburban areas have prompted many transportation agencies to turn to tolling and pricing as a method to fund new capacity and to help manage traffic congestion. There have also been many advances in travel forecasting techniques to accommodate traffic management related policies and to test feasibility of these long-term projects within major metropolitan areas. For instance, numerous studies have been conducted in Florida and San Diego regions for understanding the feasibility and financing of these projects through analysis of express lanes, dynamic pricing and other methodologies for fully utilizing highway capacity.

Since most express and managed lanes are added along central regional corridors, a majority of the studies have focused on implications of these facilities on only intra-regional travel patterns. In contrast, the representation of external demand on express/managed lanes is typically more simplistic. For instance, interregional trips are primarily represented as external stations and are an input to the model. In addition, interregional traveler demographics and behaviors, such as income and willingness to pay tolls, are often excluded from regional models.

A refined representation of external travelers can be achieved through a binary choice model that predicts the trips using toll and no-tolls roads within the traffic assignment procedure. Additionally, select link analyses can be helpful for better understanding demand in specific corridors. However, without more detailed representation of interregional travelers, the enhanced analytical methodologies still have limited information on the effects of new express lanes on interregional travel.

Overall, there is an absence of state-of-practice modeling guidelines to account for interregional travel, with a notable exception being SANDAG. Our literature search showed few studies that have looked at impacts of express/managed lanes on interregional travel. We note that even in the cases where statewide models were used, interregional travel was largely not assessed.

In at least one case – The SJCOG study –coverage of key interregional counties was included within the model system. However, this study was focused more on travel demand management, goods movement and transit improvements – not on express lanes.

3.0 Review of Potential Modeling Methodologies

A number of potential models that could be used for this study were evaluated in terms of their capability to assess the impacts of the Bay Area express lanes network on interregional travel. The following models were considered:

1. Caltrans California Statewide Travel Demand Model (CSTDM);
2. MTC Travel Model One;
3. San Francisco County Transportation Authority (SFCTA) Chained Activity Modeling Process (SF CHAMP);
4. Alameda County Transportation Commission (ACTC) Model;
5. Santa Clara Valley Transportation Authority (VTA) Model;
6. Solano Transportation Authority (STA) and Napa Valley Transportation Agency (NCTPA) Activity-Based Model (SNABM);
7. San Mateo City/County Association of Governments (C/CAG) Model;
8. Contra Costa Transportation Authority (CCTA) Model; and
9. Sonoma County Transportation Authority (SCTA) Model; and,
10. Transportation Authority of Marin Model.

Table 1 provides a brief summary of each of these models based on their modeling capabilities to capture effects of the regional express lanes network on interregional travel.

Table 2. Summary of Model Systems with Bay Area and Interregional Coverage

Agency/Model	Model Coverage Area	Express Lanes in Network?	Express Lanes in Model?	Comments
Caltrans/California Statewide Travel Demand Model	State of California	Yes	Mode Choice & Assignment.	Covers entire State of California; Includes full travel behavior of interregional travelers
MTC/Travel Model One	9 County SF Bay Area	Yes	Mode Choice & Assignment	Interregional travel assigned at Bay Area gateways
SFCTA/Chained Activity Modeling Process	9 County SF Bay Area	Yes	Assignment only	Given San Francisco's central Bay Area location, SF CHAMP is not focused on interregional travel
ACTC/ACTC Model	9 County SF Bay Area and San Joaquin County	Yes	Assignment only	For Altamont Pass: San Joaquin County trips included in full model; Stanislaus County is external gateway
SCVTA/VTA Model	9 County SF Bay Area, 3 County AMBAG Region, and San Joaquin	Yes	Assignment only	Interregional travel included for US-101-San Benito, SR 17-Santa Cruz & I-580-Altamont Pass (San Joaquin County)
STA & NVTA/SNABM	9 County SF Bay Area	Yes	Mode Choice & Assignment	Same as for MTC Model, but with updated I/X trips @ I-80/Yolo County
C/CAG/C/CAG Model	9 County SF Bay Area, 3 County AMBAG Region, and San Joaquin	Yes	Assignment only	Version of VTA Model; VTA Model is more suitable since San Mateo has no substantial interregional gateways (Santa Cruz SR 1)
CCTA/CCTA Model	9 County SF Bay Area	No	No	
TAM/MTM	9 County SF Bay Area	No	No	No interregional gateways; Model is due for replacement
SCTA/SCTA Model	Sonoma County	No	No	Not suitable

In order to conduct a review of each of the model systems, an understanding of Bay Area interregional gateways and their relationship to the proposed express lanes network is needed. The following summarizes each Bay Area interregional gateway (state highways only), with the four key gateways listed first followed by the smaller gateways.

I-80 Yolo County. This gateway is comprised of two highways, SR 113 through Davis and connecting to I-5 in Woodland, and I-80 through the Sacramento Region's main population centers. This gateway also includes the Capitol Corridor passenger train service. Proposed I-80 express lanes are slated to operate between the cities of Fairfield and Vacaville, approximately 15 miles from the regional boundary near Dixon.

I-580 Altamont Pass. At the Alameda County Line, I-580 turns south to Stanislaus County, while I-205 connects to the main population centers of San Joaquin County. I-580 also picks up long distance travelers from the Southern San Joaquin Valley counties and Southern California. This gateway also includes the Altamont Commuter Express (ACE) passenger rail service. MTC's Plan Bay Area (PBA) shows express lanes operating on I-580 between I-680 and Livermore near the base of the Altamont Pass, less than 10 miles from the interregional boundary.

US-101 Gilroy. This interregional gateway includes four significant state routes that converge in or near the city of Gilroy in Santa Clara County, including SR 152 East (Pacheco Pass), US-101 San Benito/Monterey/Greater Salinas), SR 25 (San Benito/Hollister), and SR 152 West (Santa Cruz/Watsonville). MTC's plan shows express lanes operating on US-101 through to Morgan Hill, about 10 miles from the interregional boundary south of Gilroy.

SR 17 Santa Cruz. This gateway connects Santa Cruz County's northern Communities with Santa Clara County and the rest of the Bay Area. SR 17 interregional commuters would access the Bay Area express lane network at SR 85.

Other less significant - from the perspective of the express lanes network - interregional gateways include:

US-101 Mendocino County. Express lanes network does not extend to Sonoma or Marin Counties.

SR 29 Lake County. No proposed express lanes exist in the vicinity of this rural location.

SR 128 Mendocino and Yolo Counties. Rural, low volume facility.

I-505 Yolo County. Rural, low volume facility.

SR 12 Sacramento County. Rural, low volume facility.

SR 160 Sacramento County and SR 84 Sacramento County. Rural, low volume facilities. Much of the traffic over the Antioch Bridge may come from Solano County, traveling through a short stretch of Sacramento County.

SR 4 San Joaquin County. No proposed express lanes exist in the vicinity of this rural (though fast growing) location.

SR 35 Santa Cruz County. Rural, low volume facility.

SR 1 Santa Cruz and Mendocino Counties. Rural, low volume facility.

3.1 Model Review

The following section summarizes how well each model described in Table 2 is able to capture the relationship between express lanes and interregional travel. This review is primarily based on the following aspects:

- Travel model coverage area – what is the extent of the modeling area of the planning agency?
- Interregional travel – How is interregional (or external) travel represented in the model system?
- Express lanes – Does the travel model explicitly include express lanes and toll choices?
- Interregional travel and express lanes – based on these representations, does the model have the capabilities to reflect impacts of express lanes on interregional travel?

3.1.1 Caltrans CSTDM

The CSTDM is comprised of five travel models covering long and short distance personal and commercial travel and external vehicle trips. The model coverage area is the entire State of California, with gateways at state border roadways. The long and short distance personal travel models were developed using the 2012 California Household Travel Survey (CHTS), and other data sources including MTC Plan Bay Area socio-economic data and transportation improvement assumptions. Personal travel modes include, drive alone, shared ride 2, shared ride 3+, transit, airplane and non-motorized. Three weight-based truck classifications are included in the commercial vehicle models.

Bridge and express lane tolls are included in the highway networks, skims and mode choice models. Express lanes are explicitly represented in the model with a special use code which then get assigned tolls based on occupancy level (single-occupant, shared-ride 2 and shared-ride 3+). A generalized cost highway assignment is performed that combines tolls with travel times to optimize vehicles' paths. The CSTDM uses a value of time of \$19 per hour in 2010 dollars, which is consistent with MTC model's assumptions. Model skims are updated after highway assignment and the entire model is iterated through all steps - activity generation, mode choice and assignment - until a convergence is reached (usually in 3-5 iterations).

One advantage of using the CSTDM for evaluating the effects of express lanes on interregional travel is model coverage of the entire state. The CSTDM personal travel models are tour-based and use a synthetic population database of all California residents that includes socio-economic characteristics and trip lists that cover full daily travel. Therefore, the CSTDM can capture each person's travel choices based on their socioeconomic parameters and trip purpose. Furthermore, the feedback loop allows each resident to change locations where they work and perform other daily activities based on the level of network congestion.

3.1.2 MTC Travel Model One

MTC Travel Model One is a tour-based travel demand model that covers the nine-county San Francisco Bay Area. Travel Model One explicitly recognizes express lanes in the mode choice and highway assignment models toll/non-toll choices. The toll-choice option is included in the mode choice model, where the tolls are combined with travel times to yield a generalized cost. The demand for express lanes and free highway lanes is then assigned using a binary choice model using separate free and pay paths for each vehicle occupancy level (single-occupant, shared-ride 2 and shared-ride 3+).

The interregional travel component in Travel Model One is included in traffic assignment using the external vehicle trip tables. Unfortunately, the external trip tables do not capture the socioeconomic aspects of decisions related to willingness to pay for tolls or impacts of faster travel time on mode choice. As a result, interregional travel demand does not change in response to changes in the express lane network.

3.1.3 SFCTA CHAMP

SF CHAMP is a tour-based regional travel demand model that includes the nine Bay Area counties. SF CHAMP segments traffic assignment into toll and non-toll road trips using a binary logit model. SF CHAMP, however, does not include toll and non-toll selection in the full mode choice model specification.

Ultimately, SF CHAMP is focused on travel within and between San Francisco. Since the express lanes network does not extend into San Francisco, and because SF CHAMP has no inherent advantages for modeling Bay Area interregional travel over Travel Model One, we do not recommend further analysis using SF CHAMP.

3.1.4 ACTC Model

ACTC maintains a four-step regional travel demand model that includes the nine Bay-Area counties, plus San Joaquin County. The ACTC model includes external gateways at the same locations as the Travel Model One as well as additional San Joaquin County gateways (most notable are I-5 and SR 99).

Express lanes are represented in the ACTC model as a post-processing step within traffic assignment. A binary choice model splits demand into toll choice and non-tolls choice prior to traffic assignment. However, the ACTC model does not feed back the resulting levels-of-service (i.e., congested travel times and toll costs) back through the model. As a result, express lanes do not impact the trip destinations and mode choice and also do not result in any induced interregional travel.

The ACTC Model captures some impacts of express lanes for interregional travel between San Joaquin County and the Bay Area; however, the lack of more detailed traveler information for other gateways into the Bay Area (including I-580 to Stanislaus County) makes the ACTC Model somewhat limited in its scope of application for this study. It is also unable to reflect changes in interregional demand due to the addition of express lanes.

3.1.5 Santa Clara VTA Travel Demand Model

The VTA travel model is a four-step travel demand model that includes the nine-county San Francisco Bay Area, plus four additional counties (Santa Cruz, Monterey, San Benito and San Joaquin Counties). Because of this enhanced model coverage area, the VTA model has the capability to study interregional travel at three of the four key interregional gateways (US-101 Gilroy, SR 17 Santa Cruz, and I-580 Altamont Pass-San Joaquin County only).

The VTA model toll-choice application is the same as that in the ACTC model - a post-processing step after the highway assignment where the demand for express lanes is determined. This toll-choice component is not represented in trip distribution or the mode choice model, so therefore the impacts of tolled facilities on interregional travel are not explicitly considered.

Given the larger model coverage area, the VTA Model may be the most suitable of all the Bay Area Countywide models for assessing the impacts of express lanes on interregional travel. However, the VTA

model is not as useful for assessing the entire express lanes network as the Sacramento Region and San Joaquin Valley (South of San Joaquin)/Southern California areas are not included in the model system.

3.1.6 Solano-Napa County Travel Model

The Solano-Napa Activity-Based Travel Model (SNABM) is a focused version of the Travel Model One system, with finer zonal and network representation in Solano and Napa counties. Similar to Travel Model One, interregional travel within SNABM is only represented by internal-external vehicle trip tables loaded as part of the highway assignment process. Therefore, SNABM is not recommended for further interregional travel analysis.

3.1.7 C/CAG Travel Demand Model

The C/CAG model is based on the Santa Clara VTA model, but with more detail in San Mateo County. In general, interregional travel and express lanes network are more significant transportation considerations in Santa Clara County than in San Mateo County. Therefore, the C/CAG Model is not recommended for further interregional travel analysis.

3.1.8 CCTA Travel Model

The CCTA travel model includes the nine-county Bay Area with a fine grained representation in Contra Costa County and parts of Alameda County. It considers interregional travelers at external gateway only. Contra Costa County is anticipated to contain a significant portion of the Bay Area express lane network; however, there is no tolling functionality beyond the region's tolled bridges. Interregional gateways are also located far from proposed express lanes. The CCTA Model is not recommended for interregional travel analysis.

3.1.9 Sonoma County TA Travel Model

The SCTA travel model is a traditional four-step single county model. External vehicle trip tables represent interregional travel. The regional express lanes network does not extend to Sonoma and Marin Counties, so this model is not recommended for further analysis.

3.1.10 TAM Travel Model

The MTM is an older trip-based model covering the nine-county San Francisco Bay Area. This model is slated for replacement and is therefore not recommended for further analysis of interregional travel.

3.2 Summary

A more detailed travel modeling analysis shows varying degrees of express lane tolling capabilities and interregional traveler coverage. Travel Model One has the most sophisticated toll modeling capabilities, with the tolling included within the mode choice models, and the most refined and well-validated highway network throughout the nine county San Francisco Bay Area. However, the willingness of interregional travelers to pay express lane tolls is generally not captured in Travel Model One as these are represented using static trip tables that are an input to the model.

Some of the county models – notably the VTA and ACTC Models - include some but not all adjacent external counties as part of their coverage areas. None of the countywide models include the Sacramento Region

counties; therefore, analysis of the I-80 express lanes network on interregional travel is beyond the capabilities of any of these models. In addition, these models utilize simplistic tolling methods- typically as post-processing tools.

The CSTDM has the advantage of including all travelers within the State of California as well as the ability to model express lanes, making this model system unique in its capabilities to fully assess interregional traveler decisions. We propose to utilize the functionality of CSTDM in order to assess interregional traveler demand for the Bay Area express lanes system. Our proposal is for a planning-level of analysis. Investment decisions should rely on new data collection and more comprehensive modeling approaches.

4.0 Modeling Results

As discussed in the previous section of the report, the California Statewide Travel Demand Model (CSTDm) was selected as the modeling tool for this project due to its ability to capture the interregional travel demand and inclusion of a tolling methodology within the mode choice and traffic assignment steps.

In order to assess the impact of express lanes on interregional travel, trips and vehicle miles traveled were compared for two scenarios. The baseline scenario includes a very limited express lanes network with only lanes that are already open on I-580 through Dublin, Pleasanton, and Livermore; on southbound I-680 from Pleasanton to Milpitas; and on State Route 237 between Milpitas and San Jose. The baseline network is shown in Figure 1. The build scenario includes an extensive express lanes network throughout the region as shown in Figure 2.

Figure 7. Baseline Express Lanes Network



Figure 8. Project Express Lanes Network



4.1 Methodology

Both the baseline and project scenarios used MTC’s 2040 Plan Bay Area land use and network assumptions aside from the express lane network. Both scenarios also used a value-of-time of \$19 per hour in 2010 dollars, which is consistent with the MTC model. Value-of-time is a parameter used by the model to convert travel time to cost in order to combine travel time and tolls.

For the baseline scenario, the CSTDM future-year express lanes network was updated to match the MTC network shown in Figure 1. The CSTDM network for the project scenario was updated to reflect the express lanes network shown in Figure 2. The CSTDM already included tolls on many of the future express lanes based on the 2040 Plan Bay Area Regional Transportation Plan and these were used for the initial model run. These tolls resulted in a very low express lanes utilization with volume-to-capacity ratios below 0.5 implying that very few SOV and HOV2 trips that were required to pay a toll used the express lanes - despite heavy congestion on the general purpose lanes. After reviewing tolls in the MTC model, the CSTDM tolls were adjusted to 50% of their original values (reducing the average cost per mile from \$0.28 to \$0.14), which led to higher express lanes use by SOV and HOV2 vehicles. Once the toll values were adjusted, both the baseline and project scenario runs were completed. Three speed feedback iterations were run for both the baseline and project scenarios, which is standard practice to ensure a reasonable level of model convergence.

4.2 Results

Since the focus of the study is on the impact of express lanes on interregional travel, the key metric evaluated is the number of additional interregional trips resulting from the extended network of express lanes. Interregional trips are defined as those that have one of the trip ends outside the region consisting of nine Bay Area counties. The number of interregional trips in the project scenario as compared to the baseline scenario increased by 2,800 trips out of a total of 928,000 interregional trips corresponding to a 0.3% increase. There was also a slight increase in the intraregional trips - trips that start and end within the Bay Area - as shown in Table 1. More detailed modeling results are shown in Appendix A. The increase in both interregional and intraregional trips can be attributed to better accessibility resulting from travel time savings on express lanes.

Table 3. Percent Increase in Trips between Baseline and Project Scenario

	To		
From	Bay Area	Other	Total
Bay Area	0.1%	0.2%	0.1%
Other	0.3%	0.0%	0.0%
Total	0.1%	0.0%	0.0%

Another metric used to evaluate the impact of express lanes on travel in the Bay Area is vehicle-miles traveled (VMT). As anticipated, increased accessibility stemming from the addition of express lanes resulted in an increase in VMT as shown in Table 2. Overall, the region’s VMT increased by 1.1%. However, only 17% of the additional VMT was due to an increase in interregional travel- the other 83% of the VMT increase was a result of increased trip making within the Bay Area region.

Table 4. Change in Vehicle Miles Traveled (VMT) between Baseline and Project Scenario

Period	VMT Pct Increase
AM peak (6-10 am)	2.1%
Midday (10 am-3 pm)	0.1%
PM (3 pm-7 pm)	1.7%
Off peak (7 pm-6 am)	0.5%
Total	1.1%

The last metric that is important to the evaluation of the impact of express lanes is vehicle-hours-traveled (VHT). This metric represents the number of hours that travelers spend on the road - an increase in VHT given a similar number of trips indicates a more congested network. Based on the VHT analysis, express lanes did not result in additional congestion. Table 3 shows percent of additional VHT for each time period. Despite more auto trips being made, VHT decreased for the most congested AM and PM peak periods and increased slightly in the midday and off-peak periods. The reduction in VHT in the peak periods was a result of express lanes being used by SOV and HOV2+ vehicles that were previously traveling in general purpose lanes, resulting in overall improvements in network speeds and travel times.

Table 5. Change in Vehicle Hours Traveled (VHT) between Baseline and Project Scenario

Period	VHT Pct Increase
AM peak (6-10 am)	-0.1%
Midday (10 am-3 pm)	0.2%
PM (3 pm-7 pm)	-0.4%
Off peak (7 pm-6 am)	0.6%
Total	0.0%

Overall, the study results indicate a minimal increase in interregional travel resulting from the addition of express lanes. While the corresponding increase in VMT is larger, most of the new vehicle-miles are generated by trips internal to the region. The additional trips and vehicle miles do not appear to result in more congestion in the region as the total vehicle-hours-traveled metric does not change between the baseline and project scenario.

Appendix A. Detailed Modeling Results

A.1 Statewide Trips Comparison

No Project			
	MTC Region	Other Region	Total
MTC Region	21,283,590	462,772	21,746,361
Other Region	465,211	95,714,647	96,179,858
Total	21,748,801	96,177,419	117,926,220
Express Lanes Project			
	MTC Region	Other Region	Total
MTC Region	21,309,613	463,912	21,773,525
Other Region	466,839	95,711,194	96,178,033
Total	21,776,452	96,175,106	117,951,559
Difference			
	MTC Region	Other Region	Total
MTC Region	26,024	1,140	27,164
Other Region	1,628	-3,453	-1,825
Total	27,651	-2,312	25,339
Pct Difference			
	MTC Region	Other Region	Total
MTC Region	0.1%	0.2%	0.1%
Other Region	0.3%	0.0%	0.0%
Total	0.1%	0.0%	0.0%

A.2 VMT and VHT Comparison.

No Project			
	MTC Region VMT	MTC Interregional VMT	MTC Region VHT
AM	36,566,106	5,167,489	968,850
MID	41,569,531	5,904,542	999,276
PM	42,338,930	4,941,933	1,122,071
OFF	24,998,146	4,466,335	542,244
Total	145,472,713	20,480,299	3,632,441
Express Lanes Project			
AM	37,327,812	5,286,230	967,824
MID	41,591,457	5,996,888	1,001,062
PM	43,037,619	5,011,305	1,117,353
OFF	25,133,783	4,464,903	545,384
Total	147,090,671	20,759,326	3,631,623
Difference			
AM	761,706	118,741	-1,026
MID	21,926	92,346	1,785
PM	698,689	69,372	-4,718
OFF	135,637	(1,432)	3,140
Total	1,617,958	279,027	-819
Pct Difference			
AM	2.1%	2.3%	-0.1%
MID	0.1%	1.6%	0.2%
PM	1.7%	1.4%	-0.4%
OFF	0.5%	0.0%	0.6%
Total	1.1%	1.4%	0.0%