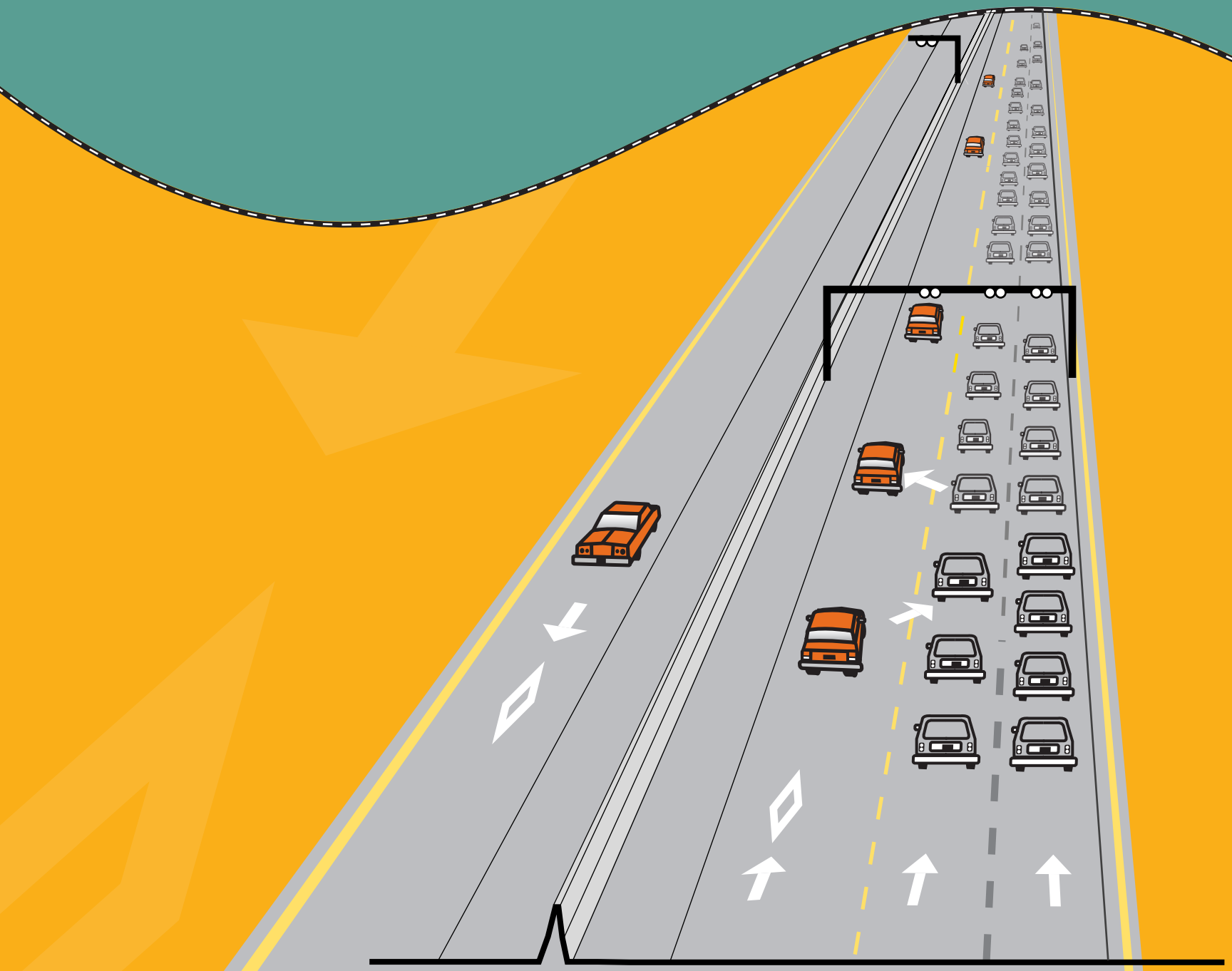
High Occupancy Toll (HOT) Credit Lanes Feasibility Study



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HOT Credit Lanes Feasibility Study

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EXECUTIVE SUMMARY

Purpose of the Study

The Fast and Intertwined Regular (FAIR) lanes concept combines the use of pricing to manage road congestion while simultaneously addressing perceived equity issues that may arise from priced roads. One frequent criticism of the high-occupancy toll (HOT) lanes concept is that it may be inequitable to low-income users who are less able to afford tolls than higher-income users. Another concern is that the general public, regardless of income, may resist HOT lanes unless they receive some tangible benefit from them even when they do not use the HOT lanes. The basic concept of the FAIR lanes proposal, as described by Patrick DeCorla-Souza (2000) in the ITS Quarterly and subsequent articles (see articles in References dated 2000-2005), is to price previously unpriced lanes to improve freeway performance and to provide a remedy to the perceived equity issues. Those equity issues are associated with the "take away" of a previously free lane and with the concern about low-income users. A FAIR lanes scheme would provide eligible users of the general purpose (GP) lanes with a "credit" each time they use the GP lane during peak periods. This credit would be redeemable toward paying their toll on the HOT lane or, potentially, other transportation services. All high-occupancy vehicles (HOV) -- carpools, vanpools and buses -- would be able to use the HOT lanes without paying a toll under all circumstances.

FAIR lanes are an innovative and untested concept. This study, which is undertaken in cooperation with the Federal Highway Administration (FHWA), was designed to test this particular equity concept on actual freeway corridors. Due to political feasibility concerns and the physical characteristics of the corridors (especially the fact that neither freeway segment has convenient, parallel free routes), a modified version of the FAIR lanes concept is applied in this study. This version is termed "High-Occupancy Toll/Credit (HOT/C) lanes in this study to distinguish it from the original FAIR lanes concept. The study applies the HOT/C lanes proposal to two specific freeway segments in Alameda and Santa Clara counties in California: Interstate 580 (I-580) and Interstate 680 (I-680).

- I-580 corridor study limits are Greenville Road to the east and the I-580/I-680 junction to the west. The facility has four GP lanes in each direction separated by a median. The length of the I-580 corridor is approximately 12-13 miles (distance varies by direction). Based on current freeway widening plans, this study assumes that I-580 will consist of four GP lanes and one HOT lane in each direction.
- I-680 corridor study limits are Route 237 (Santa Clara County) to the south and Route 84 (Alameda County) to the north. It is a six-lane facility with three GP lanes in each direction. Currently, there is one interim, non-standard HOV lane in the southbound direction. The corridor is approximately 14 miles long. Based on current freeway widening plans, this study assumes that I-680 will consist of three GP lanes and one HOT lane in each direction.

These corridors were selected because they are under active consideration for HOT lane implementation, and planning and funding for the I-680 HOT lane is already well advanced. This study analyzes key aspects of the HOT/C lanes concept including: toll revenues, impact on vehicle volumes and speeds, travel forecasting, freeway operations, and public opinion.

Alternatives Analyzed

The study reviews and compares a number of alternatives, with a focus on variable tolling scenarios. The major variables that define alternatives are: (1) crediting rate, i.e., the rate at which eligible users earn a "free" trip on the HOT lane: (2) eligibility for HOT/C lanes credits, namely the low-income only vs. all users eligibility criteria; and (3) different carpool-definition policies, namely 2-person or more (2+) vs. 3-person or more (3+) definitions of an eligible carpool. Those alternatives in which only low-income persons (defined by the U.S. government's poverty index) are eligible for HOT/C credits are

termed "Limited Eligibility" in this report. Those alternatives in which all users are eligible are termed "100 Percent Eligibility."

Both of the corridors selected for this study are characterized by a relatively affluent population, and the number of low-income users is relatively small (six percent on the I-680 and ten percent on the I-580). Although both Limited Eligibility and 100 Percent Eligibility scenarios are modeled, the study focuses more detailed analysis on Limited Eligibility, for two reasons: (1) the low-income focus addresses more directly the income equity issue, which is the most frequently raised and politically resonant "fairness" issue; and (2) the project team made a considered judgment, with concurrence from the study task force, that the 100 Percent Eligibility has no plausible chance of being enacted by policy-makers in the political and economic context of the Bay Area region, particularly due to the fact that there are no parallel roadway facilities available.

A simple low-income toll discount alternative (i.e., low-income users would pay a lower toll than other users, but there would be no crediting for their use of GP lanes) was briefly considered but discarded, because this alternative was deemed to be clearly outside the scope of the HOT/C lanes concept as defined. Nevertheless, such an alternative may be considered at a later date as a different way to address the income equity issue.

The 14 policy scenarios that met the specific purposes of the study and the screening criteria and are comparable include:

Conventional HOV Alternatives

- Scenario A: HOV 2+ carpool policy, no tolling, and no HOT/C credits granted,
- Scenario B: HOV 3+ carpool policy, no tolling, and no HOT/C credits granted

Scenarios A and B provide a base case of a conventional HOV lane for which there is no tolling and therefore no economic equity issue arising from tolling. It provides a point of comparison for measures such as vehicle speeds and volumes. It provides no revenues.

Limited Eligibility HOT/C Alternatives (low-income only)

- Scenario C: HOV 2+ carpool policy, tolling of single-occupant vehicle (SOVs), and low-income SOVs qualify for HOT/C credits at a 1 in 3 trips rate.
- Scenario D: HOV 3+ carpool policy, tolling of SOVs and HOV 2s, and low-income SOVs and HOV 2s qualify for HOT/C credits at a 1 in 3 trips rate.
- Scenario E: HOV 2+ carpool policy, tolling of SOVs, and low-income SOVs qualify for HOT/C credits at a 1 in 11 trips rate.
- Scenario F: HOV 3+ carpool policy, tolling of SOVs and HOV 2s, and low-income SOVs and HOV 2s qualify for HOT/C credits at a 1 in 11 trips rate.

Scenarios C through F examine the impacts of the Limited Eligibility HOT/C lanes policy. They compare widely varying crediting rates. They also test the impact of 2+ and 3+ carpool policies. These scenarios are the most relevant to the concept of "fairness" as defined by providing a special benefit to low-income corridor users.

100 Percent Eligibility HOT/C Alternatives (all users eligible, regardless of income)

- Scenario G: HOV 2+ carpool policy, tolling of SOVs, and 100 Percent HOT/C credit eligibility at a 1 in 11 trip rate.

- Scenario H: HOV 3+ carpool policy, tolling of SOVs and HOV 2s, and 100 Percent HOT/C credit eligibility at a 1 in 11 trip rate.
- Scenario I: HOV 2+ carpool policy, tolling of SOVs, and 100 Percent HOT/C credit eligibility at a 1 in 26 trip rate.
- Scenario J: HOV 3+ carpool policy, tolling of SOVs and HOV 2s, and 100% HOT/C credit eligibility at a 1 in 26 trip rate.
- Scenario K: HOV 2+ carpool policy, tolling of SOVs, and 100% HOT/C credit eligibility at a 1 in 51 trip rate.
- Scenario L: HOV 3+ carpool policy, tolling of SOVs and HOV 2s, and 100% HOT/C credit eligibility at a 1 in 51 trip rate.

Scenarios G through L examine the impact of providing a credit to all GP lane users who have a transponder. In order to assure free-flow conditions on the HOT lane while crediting all users of the GP lanes, the crediting rates need to be very low, so the credit may be viewed by users as almost negligible.

Conventional HOT Lane Alternatives

- Scenario M: HOV 2+ carpool policy, tolling of SOVs and no HOT/C credits.
- Scenario N: HOV 3+ carpool policy, tolling of SOVs and HOV 2s, and no HOT/C credits.

Scenarios M and N are "pure" HOT lanes and also provide a basis for comparison with the HOT/C lanes scenarios. They provide a "zero credit" to GP lane users of any income and represent the conventional HOT lane. They are useful alternatives in terms of comparing revenue generation as well as traffic conditions.

Ingress/egress to the HOT lanes on the I-580 and I-680 corridors would be limited to certain locations, at the beginning and end of the HOT lane and at several intermediate access locations along the corridor. Access locations were dictated by factors such as traffic demand, distance from key interchanges, and operational and safety considerations.

Public Opinion and Acceptance

In order to assess public and stakeholder attitudes towards both the HOT/C lanes concept and value-priced lanes, the study team conducted focus groups with frequent users of I-580 and I-680. In addition, a public opinion survey of residents in Alameda County and the surrounding communities was also conducted.

Findings from both the focus group research and the public opinion survey suggest that the single most important factor determining support or opposition to HOT lanes is the context in which they are presented to the public. When presented as a toll lane, designed to manage congestion, give commuters choices and fully utilize carpool lanes, respondents were generally skeptical. When presented as a carpool lane with a revenue enhancing element designed to deliver desirable transportation improvements, most notably completing carpool lanes and expanding express bus service, residents strongly support the idea. Once a desirable context is set, residents were much more likely to accept and embrace the other beneficial outcomes of the project (e.g., more choices, congestion relief and full utilization of the carpool lane).

The public opinion research in this study strongly suggests that concerns about income equity are not a major determinative factor in public acceptance of HOT lanes. To the degree that fairness is an issue at all, it is defined as a concern that the wealthy would be able to buy their way out of traffic rather than that the poor would not be able to buy their way into the lane. For the average resident,

allowing poor residents into the lanes for a discount only makes the plan less equitable, as it appears that exceptions are being made for everyone but them. Most importantly, the research suggests that most residents are willing to accept that not everyone will be able to access the HOT lanes, if the outcome is a better transportation system for all.

Cost

The total estimated incremental capital cost to implement HOT/C lanes on I-680 is $1,177,500, and the estimated incremental annual Operations & Maintenance (O&M) cost is $155,340. The total estimated incremental capital cost to implement HOT/C lanes on I-580 is $1,603,125, and the estimated incremental annual O&M cost is $189,125. Capital and O&M costs for both corridors are estimated on the basis of Limited Eligibility alternatives; capital costs for both corridors include a 25 percent contingency factor. The I-580 capital costs are higher, because I-580 will have four GP lanes in each direction (requiring more antennas, readers and structure for reading transponders in the GP lanes), while there are three GP lanes on I-680. The I-580 O&M costs are higher than I-680, due to maintenance of more equipment and a somewhat higher number of transactions.

The total capital cost for implementing Limited Eligibility HOT/C Lanes for both I-580 and I-680 corridors combined is $2,630,625. The total annual O&M cost for both corridors combined is $345,194. (Note: the HOT facilities on both corridors are assumed to be in place for this estimate).

HOT/C Policy Modeling Results

The economic and performance impacts of various HOT/C Lane policy scenarios are analyzed in terms of revenue generated and several traffic measures, such as vehicle speeds and volumes.

The key findings are:

1. There would be a significant opportunity cost to the public, in the form of forgone HOT lane revenues, associated with HOT/C lane credits that are redeemed. This result may differ from the original FAIR Lanes concept, because that concept priced an additional HOT lane and, therefore, revenue potential could be higher.
2. There are modest improvements in overall travel time savings (unweighted by the value of time) that would accompany adoption of HOT/C lane policy.
3. The eligibility and HOT/C crediting policies adopted influence the operating characteristics of the overall facility. A low-income-based eligibility criterion severely limits the number of eligible users, by definition (especially in these relatively affluent corridors) and permits a more generous crediting policy, everything else being equal. Adoption of a 100 Percent Eligibility policy necessitates severely limiting the accrual rate of HOT lane credits provided for each GP lane trip.
4. The relative generosity of the HOT/C credit policy, as well as the choice of carpool policy, has a significant impact on revenues and facility speed performance. For example, in the 100 Percent Eligibility scheme, an HOV 2+ carpool policy with a 1 in 11 trip HOT/C credit policy is essentially inoperable, due to overloading by free riders, on I-580 in both horizon years and marginally operable on I-680.
5. There is also a high risk that users who have accumulated HOT/C credits may wish to utilize them during the same peak period on the same day, thereby nullifying their practical value to users.
6. The amount of equity value that can be offered by a HOT/C lanes policy is limited substantially by the need to limit crediting rates in order to maintain satisfactory service on the HOT lane.

Revenue Estimates

Even under the most conservative assumptions, HOT lane tolling generates significant revenues over a 20-year period. The results, however, reveal the great sensitivity of revenues to both HOT/C and carpool policy. HOT lane revenues are produced most prolifically when there is substantial HOT lane capacity to be sold - when there is a 3+ carpool policy in place and there are no "free riders" as a result of the HOT/C policy. The addition of HOT/C users and a generous 2+ free carpool policy has significant negative effect on HOT lane revenues. Both policies have the effect of reducing the capacity that is available to sell, the volume of paying users, and therefore the total revenue generated. The assumed Real Discount Rate also has a significant effect on total revenues. Under the most diverse scenarios and assumptions tested in this study, yielding the highest and lowest revenues, the Limited Eligibility alternatives for I-680 yield a range of 20-year revenues from approximately $120 million to $331 million, and for I-580 a range from $18 million to $167 million. The 100 Percent alternatives for I-680 yield a range of revenues from $76 million to $309 million, and for I-580 a range from $10 million to $159 million. The low end of the revenue ranges is characterized by these assumptions: most generous crediting policies (100 Percent Eligibility), HOV2+ carpool policy, and highest real discount rate. The high end of the revenue ranges is characterized by the opposite assumptions: least generous crediting policies (Limited Eligibility), HOV3+ carpool policy, and lowest real discount rate.

Revenues are also significantly affected by the assumed sensitivity of total facility usage with tolls in place and whether or not increases in real household purchasing power are assumed. The revenue estimates depend upon the extent to which SOV and carpool volumes are sensitive to the tolls. If there is little total response of traffic to the presence of tolls, and real income growth is assumed, total revenues could be substantially more than derived under the more conservative assumptions that are provided.

Operational Analysis

A qualitative evaluation and limited quantitative evaluation of two of the 14 scenarios is provided for I-580 and I-680. The two alternatives selected for study of each facility represent the extremes, the least and most HOT/C lane impacts among the proposed Limited Eligibility scenarios under consideration. The rationale for selecting the two extreme scenarios is to establish a range of impacts for analytical purposes. The 100 Percent HOT/C lane was not included in this operational analysis, because it is deemed highly unlikely to be implemented. The two selected scenarios are:

- Scenario M is a conventional HOT lane with a 2-person carpool policy and no HOT/C policy. Year 2000 conditions are evaluated. This is the scenario with no impact of HOT/C policy.
- Scenario C of the alternatives in this study is a Limited Eligibility HOT/C lane with a 2-person policy and a 1 in 3 trips crediting rate. This concept has the highest volume of traffic that would use the HOT/C lane. Under this scenario, drivers can pay to use the lane, ride free if they are a 2+ carpool, or if they qualify as low-income they can be credited for one usage of the lane for every three trips of the GP lanes. Year 2025 conditions are evaluated.

Scenario C (maximum usage) demand volumes appear to be close to or slightly over capacity for I-580, but not for I-680, while Scenario M (minimum usage) demand volumes seem to be well below capacity. It is reasonable to assume that ramp metering will be in place by the time any such lane is constructed, so it is likely the volumes could be controlled enough to keep actual volumes within capacity.

One key element to successful operations would be the physical construction of the lane, particularly the type of buffer separating the HOT lane from the adjacent lanes and the width of shoulders, both of which would increase the capacity if designed optimally. Another element would be the locations of the access points relative to the access interchanges. The location of entry points should be as far

as feasible from the interchange that nominally serves the lane, but upstream enough from the next interchange's on-ramp.

By focusing the operational analysis on the two alternatives representing the extremes of the proposed lane configurations (least usage and most usage by vehicles using HOT/C credits), the analysis brackets the range of potential impacts. The analysis shows that the concepts studied in the report would function adequately for all the Limited Eligibility scenarios. Some of the scenarios, specifically 2025 with HOV-2 free and generous HOT/C crediting may strain the lane and produce service levels worse that LOS D, but this performance would still be better than the freeway mainline GP lanes.

HOT/C Lanes Feasibility Considerations

The findings of the HOT/C lanes alternatives and conclusions are:

1. There is a cost to the public, in the form of forgone HOT lane revenues, by adopting a HOT/C lane policy, whether Limited Eligibility or 100 Percent. Because addition of non-paying vehicles using their HOT/C credits results in a decline in the performance of the HOT lane and a smaller capacity to "sell" to paying vehicles, the number of paying vehicles and the amount they are willing to pay are reduced. In addition to the loss of revenue due to less capacity to sell, there is a direct loss of revenue associated with HOT/C Lane participants who would have otherwise paid to use the HOT lane.
2. The 3+ carpool policy performs much better in terms of revenue than does the 2+ policy, under all HOT and HOT/C policy scenarios.
3. The opportunity costs are particularly high on the I-580 HOT lane under the 2+ carpool policy because of the projected high utilization of the lane by non-paying users.
4. The Limited Eligibility criterion for HOT/C credits does not have a major impact on the facility operations when crediting levels are not generous (i.e., 1-in-11 trips for free), because so few users meet the criterion and it takes numerous trips to build up enough credits for a "free" trip. However, the relatively generous crediting policy (1-in-3 free trips) does make a significant dent in revenue, especially in the context of the 20-year revenue stream. The 100 Percent Eligibility criterion, on the other hand, has a major impact on the operation of the facility and on revenues in both the short-and long-term. Therefore, the crediting rates must be very low (1-in-26 or lower), so the credits are almost negligible and may not be worth the administrative or public relations difficulties entailed.
5. The incremental capital cost for implementing HOT/C lanes system on I-580 and I-680 HOT lanes would be approximately $2.8 million. The incremental annual O&M cost of implementing the HOT/C lane policy on HOT lanes in both corridors is $345,140. While not insignificant, these costs may be deemed worthwhile, if they truly address a public perception of inequity that would otherwise be a major obstacle to adoption of HOT lanes. As noted above, the major cost of adopting a HOT/C lanes policy on HOT lanes is the forgone revenue.
6. HOT/C lanes alternatives provide modestly lower speeds on the HOT lane as compared to the pure HOT Lane alternatives.
7. The HOT/C lane alternatives are characterized by fewer toll-paying customers on the HOT lanes.
8. There are modest improvements in overall net time savings for the entire freeway that accompany the HOT/C lane policy. On the margin, moving a vehicle off of the congested GP lane to the less congested HOT lane reduces facility-wide vehicle hours

traveled. However, the net gain per HOT/C lane user is small and the losses to HOVs and paying HOT lane users must be weighed in light of California's policy to favor HOVs.

9. There is also a high risk that users who have accumulated HOT/C lanes credits may wish to utilize them during the same peak period on the same day. For example, an incident causing serious traffic congestion on the GP lanes would provide an incentive for users with accumulated HOT/C lanes credits to use them simultaneously. Hence, the performance of the HOT lane may deteriorate very sharply as a result of high demand. In this sense, the value of the HOT/C lane credits may evaporate under precisely the operational conditions under which users may wish to redeem them.

Implementation Challenges

The implementation of HOT/C lanes on I-580 and I-680, as an additional feature of a HOT lanes program, faces several major challenges. A HOT/C lanes system on both freeways would need to satisfactorily address the following issues.

1. **Agency and stakeholder consensus**. Numerous local and state official decision-makers and other stakeholders would need to reach consensus that a HOT/C lanes concept, which has never been tried elsewhere, is an experiment worth implementing. If undertaken, it would be an attempt to address a perceived equity problem with HOT lanes that would otherwise be a serious obstacle to gaining their acceptability with the public.
2. **Equity concerns**. Equity concerns, as they pertain to low-income users, may be important to elected officials, transit advocates, and other leaders, but they do not appear to be as important to the general public, as found in this study. Decision-makers would need to determine that this equity concern is significant enough as an impediment to adoption of HOT lanes that it warrants introducing a complication into the toll structure, operation, and administration into the HOT lanes. They may also wish to consider other ways to address this perceived equity issue.
3. **Corridor travel impacts**. Because HOT/C lanes customers, when they use their accumulated credits, will to some degree take space that would otherwise be available for regular carpools or toll-payers, they will have an impact on corridor performance. Decision-makers will need to assess whether the benefits for some outweigh the adverse impacts for others, including toll-payers who will be confronted with the higher toll rates needed to balance scarce supply with the demand.
4. **Use of revenues**. Because a meaningful HOT/C lanes credit means forgone revenue, there will be less revenue available to fund other purposes, such as paying for bonds to build the HOT lanes, other corridor capital improvements, or improved transit service on the corridor. This represents a challenging policy decision, because it requires balancing different sets of values, such as equity, that are difficult to quantify.

1. INTRODUCTION

1.1 Background of the FAIR Lanes Concept

The Fast and Intertwined Regular (FAIR) lanes concept combines the use of pricing to manage road congestion while simultaneously addressing perceived equity issues that may arise from priced roads. One frequent criticism of the high-occupancy toll (HOT) lanes concept is that it may be inequitable to low-income users who are less able to afford the tolls than are users with a higher income. Another concern that has been expressed is that the general public, regardless of income, may resist HOT lanes unless they receive some tangible benefit from them even when they do not use them.

The basic concept of FAIR lanes is to provide eligible users of the general purpose (GP) lanes with a "credit" each time they use the GP lane during peak periods. The original concept is outlined in an article by Patrick DeCorla-Souza in a series of articles and papers. As described by DeCorla-Souza (2000) in an article in the ITS Quarterly[1] the FAIR lanes concept attempts to maximize priced lane throughput, speed, safety, driving comfort and revenue by allocating two lanes to "fast" lane use, one or both of which would be taken from GP use. To compensate those currently using the GP lanes for the lane "take away," credits would be given to all GP lane users with transponders for each use during peak periods; these credits would be redeemable toward paying the toll on the "fast" or HOT lanes, or potentially for other transportation purposes. The proposal subsequently evolved to also provide for "toll and transit fare credits or refunds for low income commuters to address equity impacts and reduce the incentive for them to divert to an alternative free route."[2] All high-occupancy vehicles (HOVs) would be able to use the HOT lanes without paying a toll.

In August 2001 the ENO Transportation Foundation conducted focus groups in New York City to test commuters' response to the FAIR lanes concept, as well as HOT lanes. The focus group participants were solo-driver commuters from the outer boroughs of New York City into Manhattan (clearly, a very different context from the corridors that are the subject of this present study). The majority indicated overall support for FAIR lanes, also described in this setting as "Fast Lanes," in which HOVs would ride for free and low-occupancy vehicles paid a toll. However, the solo drivers indicated that, unless there are unusually pressing needs, they would normally ride the free lanes to avoid the toll. Although the participants understood credits in terms of accumulation, several participants had difficulty understanding that the credits were compensation for the conversion of an existing free regular lane into a fast HOV alternative. After having the concept explained in detail and being told that their credit would be equivalent to 25 percent of the toll at the time they are traveling, the participants' reaction was "generally positive." Thus, for the clear majority who would ride the free lanes on a normal basis, the credits were regarded as "getting something for nothing."[3]

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[1] DeCorla-Souza, Patrick. FAIR Lanes: A New Approach to Managing Traffic Congestion." ITS Quarterly, Spring 2000 Issue. Vol. VIII Number 2.

[2] DeCorla-Souza, Patrick. *Clearing Existing Freeway Bottlenecks with Fast and Intertwined Regular Networks: Costs, Benefits and Revenues*. Prepared for presentation at the TRB Annual Meeting in January 2004. Paper No. 04-3993. November 15, 2003.

[3] Eno Transportation Foundation. *The Role of Fast and Intertwined Regular (FAIR) Lanes in the New York Metropolitan Region*. Conference on September 6, 2001 in New York, New York.

1.2 Focus of I-580 and I-680 Study

This study modifies the FAIR Lanes concept in three significant ways:

(1) There is no GP lane "take away" involved, for reasons described below.

(2) Examines use of the credits only for paying tolls on the HOT lanes, because that is considered by far the most likely use by commuters in these suburban corridors. The project task force made a judgment at the outset that there is no practical or foreseeable opportunity to establish a program of parking charges, neither at park-and-ride lots nor for taxi/limousine in the corridor. The team also determined that using the credits for transit fares in corridors without any realistic opportunity for robust transit service, while theoretically possible, would result in negligible behavioral change and impacts on the corridor and would be impossible to capture in the travel and economic modeling.

(3) Considers two definitions of GP lane users eligible for credits: all users and low-income users only. The low-income definition is meant to specifically target and address the socioeconomic equity concerns that are often raised in HOT lane discussions. In this study the alternatives with eligibility based on low-income only are termed "Limited Eligibility and apply the definition of low-income used by the Metropolitan Transportation Commission (MTC), i.e., 200 percent of the U.S. government's official poverty index. The alternatives with eligibility for all users are termed "100 Percent Eligibility."

FAIR lanes are an innovative and untested concept. This study, which is undertaken in cooperation with the Federal Highway Administration (FHWA), was designed to test this particular equity concept on actual freeway corridors. Due to political feasibility considerations, it was decided that a modified concept, termed High-Occupancy Toll/Credit (HOT/C) in the remainder of this report, would be applied to two specific freeway segments in Alameda and Santa Clara counties in California: Interstate 580 (I-580) and Interstate 680 (I-680)

- I-580 corridor study limits are Greenville Road/Altamont Pass Road to the east and the I-580/I-680 junction to the west. The facility has four GP lanes in each direction separated by a median. The length of the I-580 corridor is approximately 12-13 miles. Based on current freeway widening plans, this study assumes that I-580, at the time of implementation of potential HOT lanes, will consist of four general purpose (GP) lanes and one HOT lane in each direction.
- I-680 corridor study limits are Route 237 (Santa Clara County) to the south and Route 84 (Alameda County) to the north. It is a six-lane facility with three GP lanes in each direction. Currently, there is one interim, non-standard high-occupancy vehicle (HOV) lane in the southbound direction. The corridor is approximately 14 miles long. Based on current freeway widening plans, this study assumes that I-680, at the time of implementation of potential HOT lanes, will consist of three general purpose lanes and one HOT lane in each direction.

This study analyzes key aspects of the HOT/C lanes concept including: toll revenues, impact on vehicle volumes and speeds, travel forecasting, freeway operations, and public opinion.

The study reviews and compares 14 policy scenarios in all. These scenarios meet the purposes of the study and the screening criteria. The scenarios include the following categories:

- Conventional high-occupancy-vehicle (HOV) lanes, with no tolling and no HOT/C credits.
- Conventional high-occupancy-toll (HOT) lanes, with free passage for HOVs, tolling for non-HOVs, but no HOT/C credits.
- HOT lanes with HOT/C credits for low-income users only (Limited Eligibility).
- HOT Lanes with HOT/C credits to all users regardless of income (100 Percent Eligibility).

Furthermore, the study further explores variations of these scenarios in order to test the sensitivity to different factors. These factors include different carpool eligibility policies, different horizon years, and variable crediting rates for HOT/C-eligible vehicles.

The chapters that follow first place the study in its physical and policy context, and then proceed to analyze systematically these various scenarios. The study is the first comprehensive application of the HOT/C adaptation of the FAIR lanes concept as a potential way to address one aspect of the equity concerns often raised in connection with HOT lanes proposals. The equity issue is only one challenge faced by value pricing or road pricing proposals: a survey of the value pricing "state-of-the-art" appears as **Appendix A** of this report.

While this study includes analysis of both the low-income (Limited Eligibility) and the all-users (100 Percent Eligibility) HOT/C lanes crediting schemes, the analysis is more detailed for the Limited Eligibility options. This focus is a result of the deliberate and considered judgment of the project study task force, which concluded that the low-income scheme (Limited Eligibility) has a far greater likelihood of being implemented by the policy-makers in this region than does an all-users scheme. The political unacceptability of the 100 Percent Eligibility scheme, arising from concerns about both income equity and about excessive loss of revenue, led to this conclusion.

Finally, the study task force also concluded that the prospect of converting existing free lanes into priced lanes on these corridors is remote that it would not merit consideration. Both of these freeway corridors lack convenient, parallel route alternatives. Furthermore, local and state elected officials have indicated strong opposition to any pricing or "take away" of existing free facilities.

2. EXISTING CONDITIONS

This section describes the physical and operational characteristics of the Interstate 580 (I-580) and Interstate 680 (I-680) corridors. This summary of existing conditions relies on currently available data.

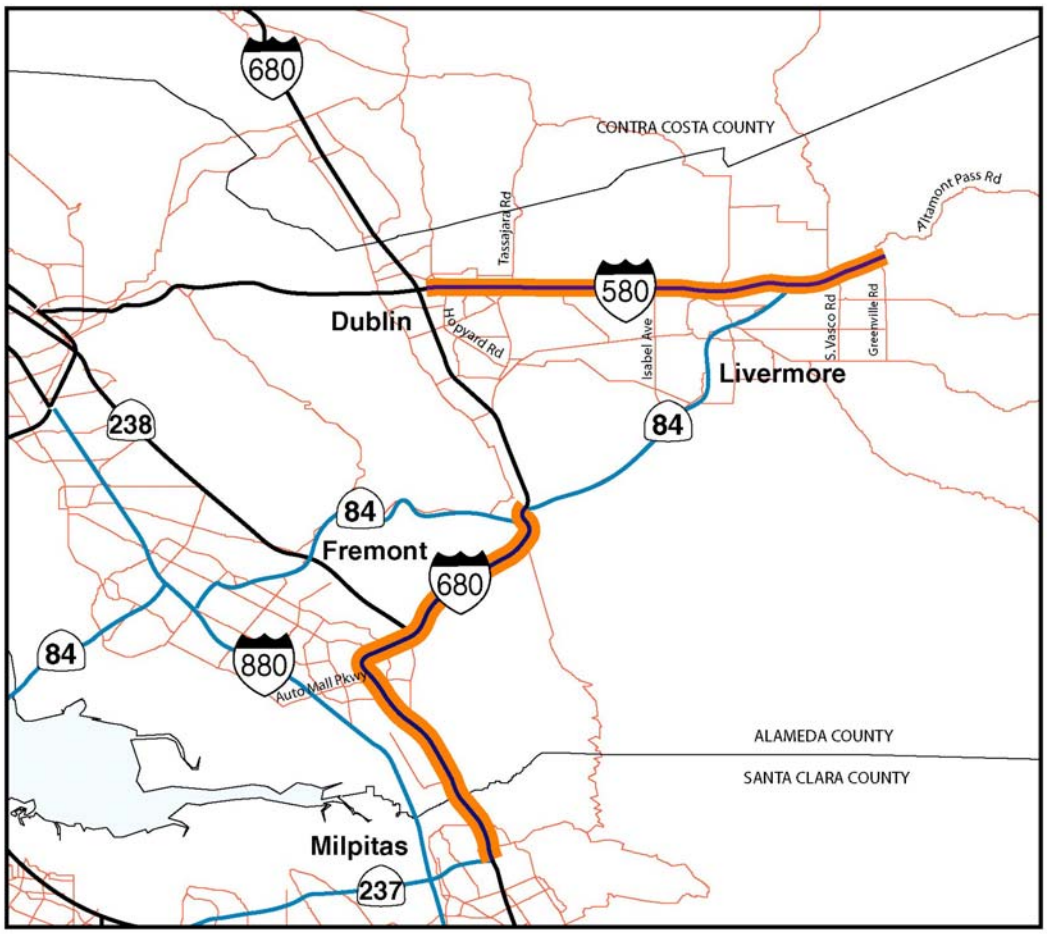
2.1 Physical Characteristics

Interstate 580

The study limits for I-580 are Greenville Road/Altamont Pass Road to the east and the I-580/I-680 junction to the west. The facility has four GP lanes in each direction separated by a median. The median varies in width between 36 and 42 feet.[4] BART operates along I-580 in the median and terminates at the Dublin-Pleasanton BART station at the west end of the I-580 study area.

The length of the I-580 corridor between I-680 and Greenville Road is approximately 12 miles. This section is contained entirely within Alameda County.

Figure 1
Project Location



[4] "ALA 580 KP 15.6-28.9 (PM 936-17.9) HOV Lanes, EA: 29080K," Caltrans, 2001.

Interstate 680

The study limits in the I-680 corridor are Route 237 (Santa Clara County) and Route 84 (Alameda County). It is a six-lane facility with three GP lanes in each direction. Currently, there is one interim, non-standard HOV lane in the southbound direction. This lane opened in December 2002 and the plan is to have it completed to full freeway standards by 2008. The corridor is approximately 14 miles long. Approximately 80 percent of this section is located in Alameda County and the remainder in Santa Clara County.

The size of medians, the design of overcrossings and the placement of columns within the medians varies throughout the corridor. The northbound and southbound directions of the roadway have different elevations in almost half of the corridor.[5]

2.2 Operational Characteristics

Peak Hour and Daily Traffic Volumes

The California Department of Transportation (Caltrans) provided mainline and ramp 24-hour count data for both corridors. Most of the data was collected in 2003 and reflects all days of the week. To summarize the data, the most recent weekday counts were used. Generally, the most recent data was counted between May and October, which is typically when the highest counts are collected. For each hour, the highest value was identified. From these numbers, the highest morning value (midnight to noon) value and the highest evening value (noon to midnight) were identified as the AM and PM peak hours.

Interstate 580

Figures 2 and 3 show weekday eastbound and westbound daily mainline volumes for I-580. Both figures show distinct peak levels of activity. In the westbound direction, the peak occurs in the morning indicating most jobs are west of this corridor. In the eastbound direction, peak traffic occurs in the afternoon. Both figures show smaller peaks in the reverse commute direction.

Congestion in this corridor has consistently increased over time. In 2001, the segment of eastbound I-580 between Hopyard Road and El Charro Road was the fifth most congested freeway in the Bay Area in the afternoon; it was ranked 13th in 2000. Today it is the third most congested freeway in the Bay Area in the PM.[6,7]

Interstate 680

Figures 4 and 5 show daily weekday northbound and southbound daily mainline volumes for I-680. Both figures show a large peak and a small peak. In the northbound direction, the large peak occurs in the afternoon with a smaller peak in the morning. The large peak occurs in the morning in the southbound direction. Therefore, the peak commute direction is towards jobs in Santa Clara County and southern Alameda County. These figures also indicate that although there is a predominant commute direction southbound (AM peak period) and northbound (PM peak period). The northbound AM and southbound PM reverse commute is also significant. These volumes include both GP and HOV lane traffic volumes.

The southbound segment of I-680 between Sunol Road and Route 262 also has consistently placed in the "top 10" of the locations with the worst congestion in the Bay Area. However, over the past few years, its position has improved, possibly due to a reduction in traffic due to the economic downturn.

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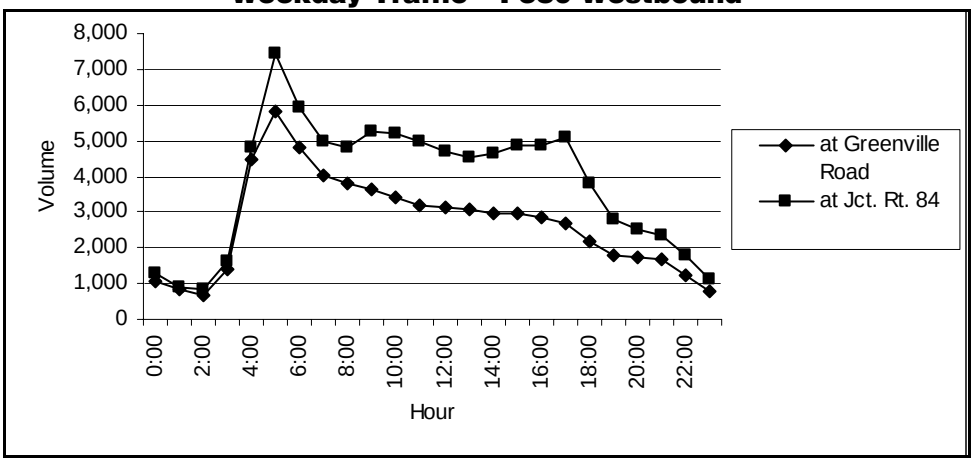
[5] "I-680 Value Pricing Study Operations Analysis," Final Report, Alameda County Congestion Management Agency, September 19, 2003.
[6] "Information Memorandum: Year 2001 Bay Area Freeway Congestion Data," Caltrans District 4 Office of Highway Operations.
[7] "Information Memorandum: Year 2002 Bay Area Freeway Congestion Data," Caltrans District 4 Office of Highway Operations.

In 2000, the segment was ranked second. In 2001, it improved to third, and in 2002 it was ranked eighth.

Caltrans also collects information on the usage of HOV lane versus GP lanes. For the I-680 southbound lane (between Route 84 and Route 237) during the AM peak hour, seven percent of all vehicles used the HOV lane and 11 percent of all persons traveling southbound in the corridor used the HOV lane.[8]

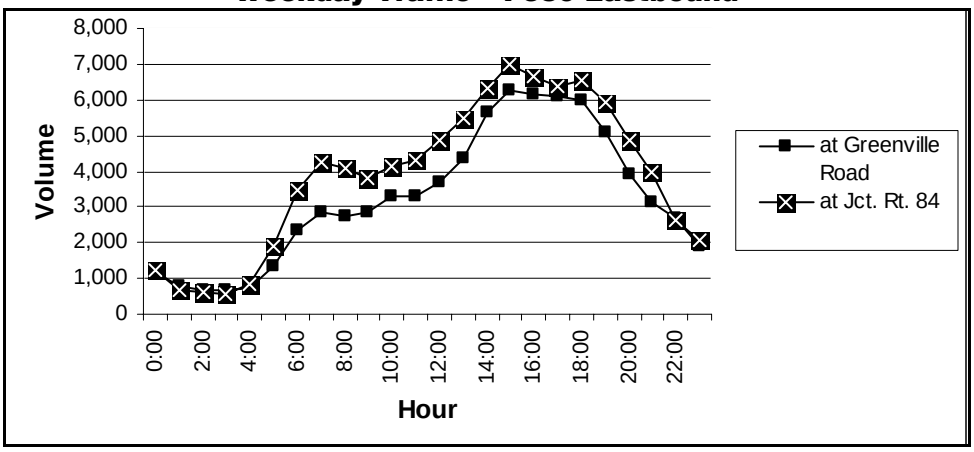
Prior to the introduction of the HOV lane, there were rapid increases in delays on I-680 due to high peak period travel demand, especially between 1990 and 2001. Since then, the slow economy has resulted in reduced travel times and congestion levels.

Figure 2
Weekday Traffic – I-580 Westbound



Source: Caltrans 24-hour count data.

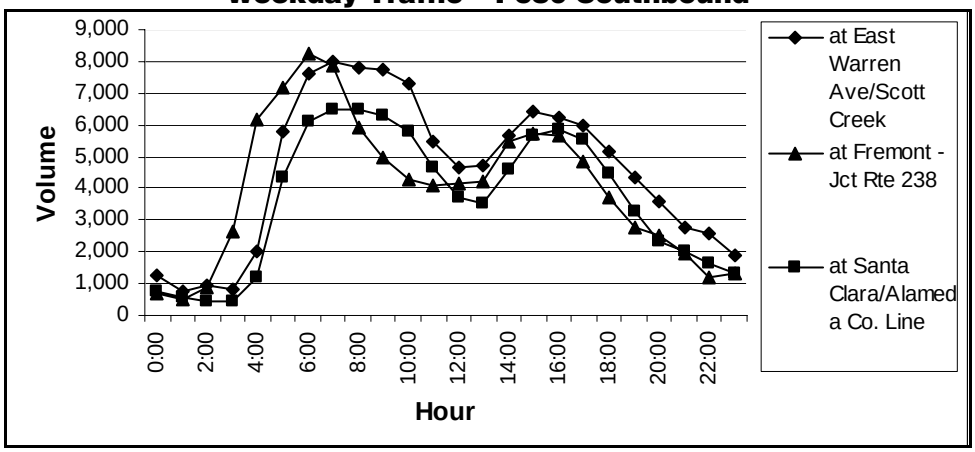
Figure 3
Weekday Traffic – I-580 Eastbound



Source: Caltrans 24-hour count data.

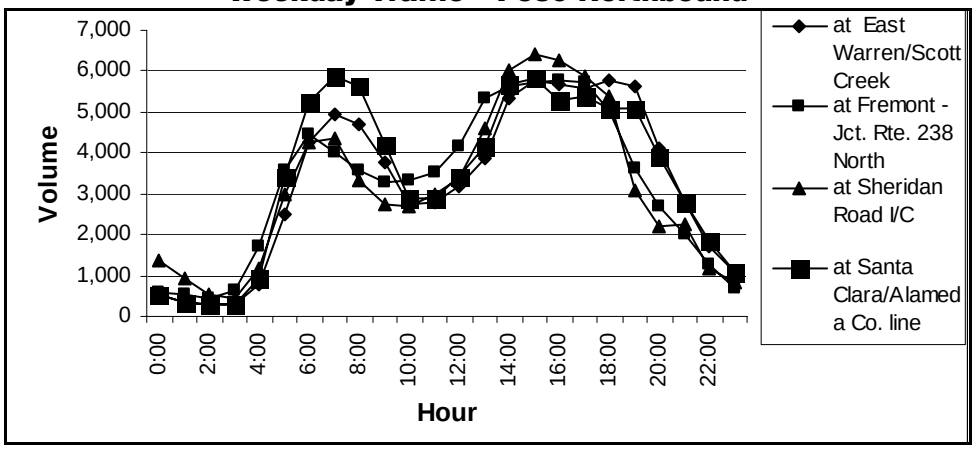
[8] "HOV Lanes in the Bay Area," Caltrans District 4, 2002.

Figure 4
Weekday Traffic – I-680 Southbound



Source: Caltrans 24-hour count data.

Figure 5
Weekday Traffic – I-680 Northbound



Source: Caltrans 24-hour count data.

Table 1 summarizes average daily traffic (ADT) volumes data for each facility.

Table 1
Average Daily Traffic

Location	Date	ADT
I-580		
Eastbound		
Livermore – Greenville Road	July 2002	77,700
Jct Rte 84	July 2002	92,600
Westbound		
Livermore – Greenville Road	July 2002	64,300
Jct Rte 84	July 2002	91,200
Both Directions		
Livermore – Greenville Road		142,000
Jct Rte 84		183,800
I-680		
Northbound		
East Warren/Scott Creek	July 2002	78,400
Fremont Jct Rte 238 North	August 2003	77,200
Santa Clara/Alameda Co Line	August 2000	82,000
Southbound		
East Warren/Scott Creek	July 2002	109,500
Fremont Jct Rte 238 North	July 2003	97,100
Sheridan Road I/C	January 2004	75,400
Both Directions		
East Warren/Scott Creek		187,900
Fremont Jct Rte 238 North		174,300
Sheridan Road I/C		157,400

Source: Caltrans District 4 Highway Operations, Traffic Volumes Counts.

Traffic volumes in these corridors have risen steadily over time. Table 2 shows the increase in average daily traffic volumes (ADT) since 1994.

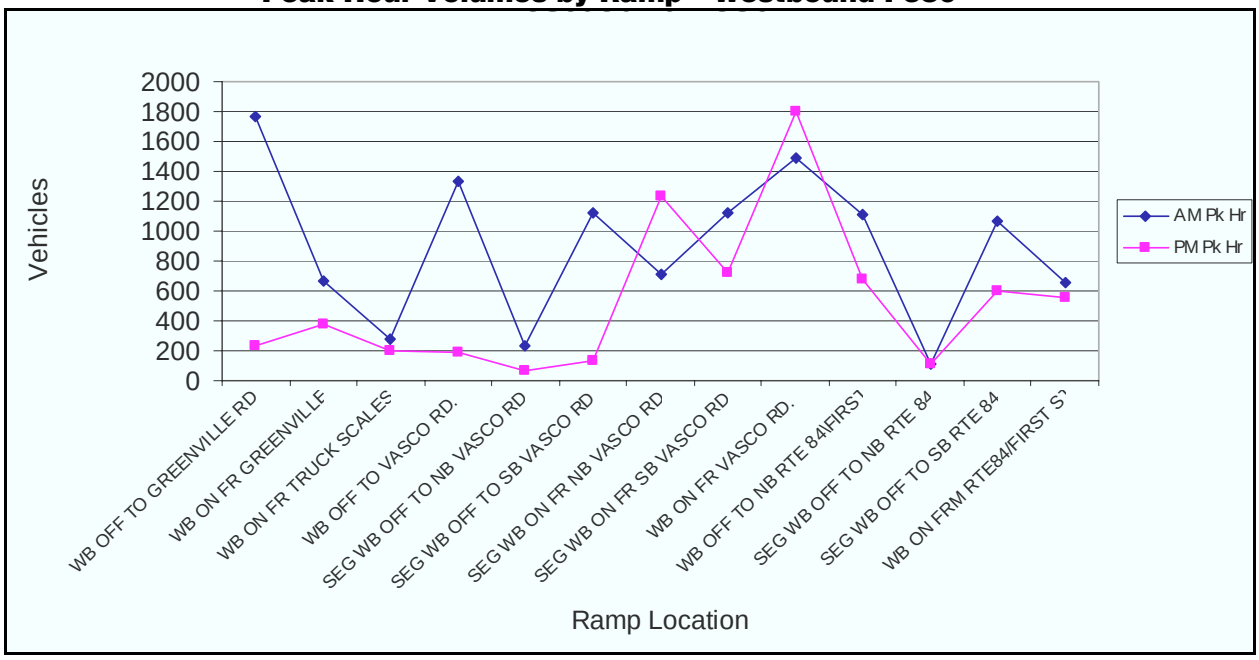
Table 2
Historical Change in Average Daily Traffic Volumes

Location	1994 ADT	Current ADT	Annual Increase	Overall Increase
I-580				
Livermore – Greenville Road	102,000	142,000	3%	28%
Jct Rte 84	126,000	183,800	4%	31%
I-680				
East Warren/Scott Creek	114,000	187,900	5%	39%
Fremont Jct Rte 238 North	109,000	174,300	5%	37%
Sheridan Rd I/C	109,000	157,400	4%	31%

Source: Caltrans District 4 Highway Operations, Traffic Volumes Counts (2000-2004).
"1994 Traffic Volumes on California State Highways," Caltrans Division of Traffic Operations.

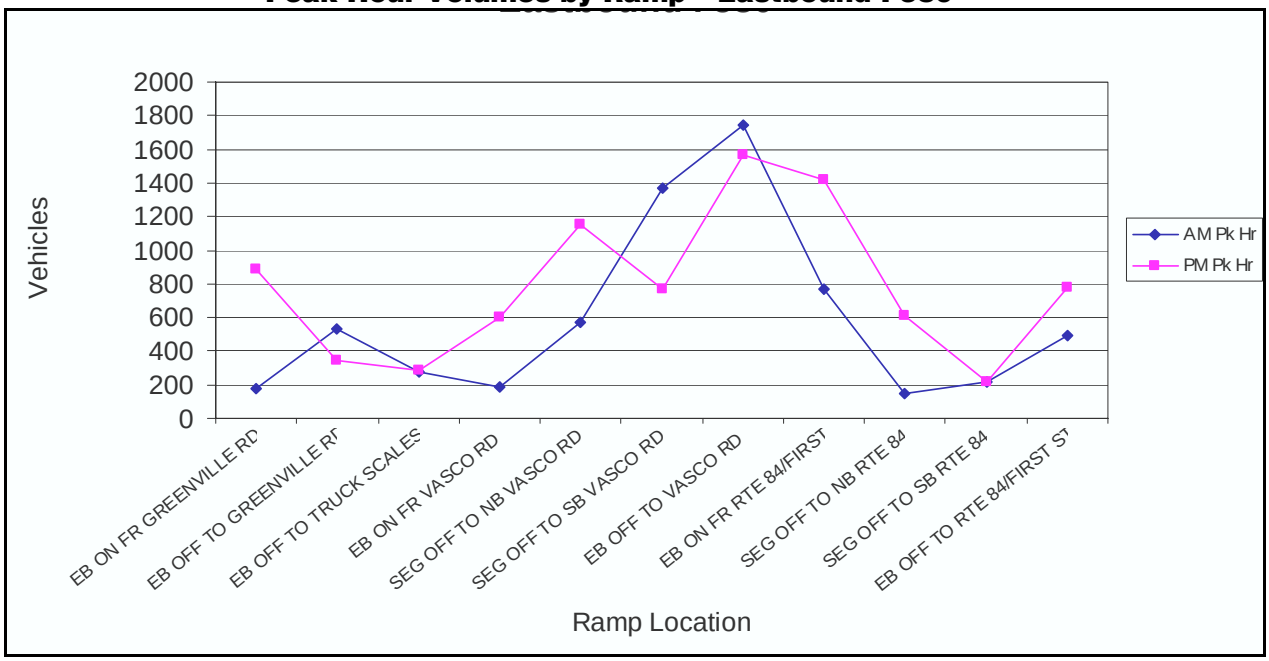
Figures 6, 7, 8 and 9 show peak hour ramp volumes for each facility.

Figure 6
Peak Hour Volumes by Ramp – Westbound I-580



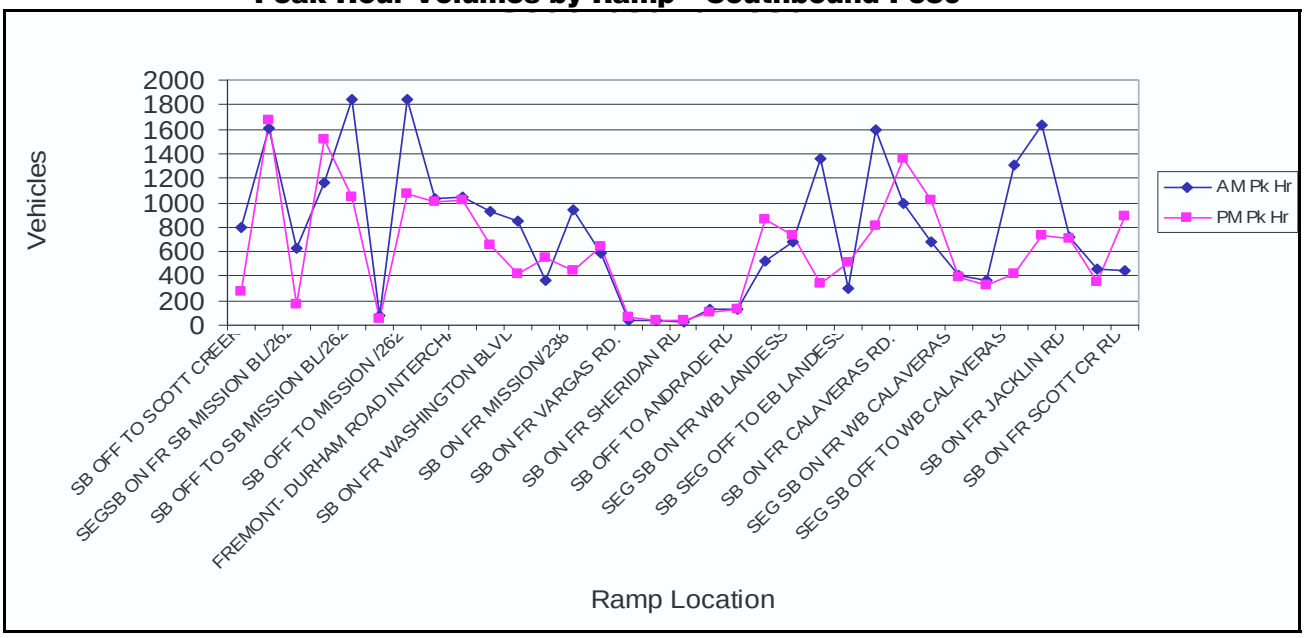
Source: Caltrans District 4 Highway Operations, Traffic Volumes Counts (2000-2004).

Figure 7
Peak Hour Volumes by Ramp – Eastbound I-580



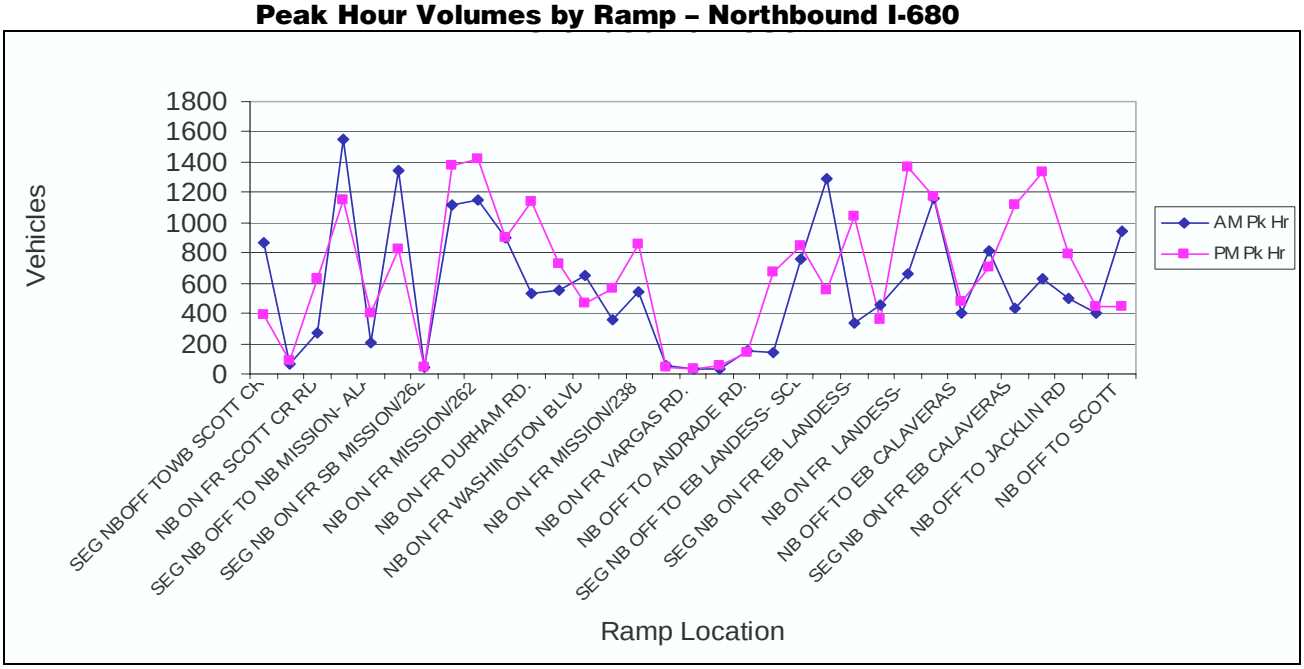
Source: Caltrans District 4 Highway Operations, Traffic volume counts (2000-2004).

Figure 8
Peak Hour Volumes by Ramp – Southbound I-680



Source: Caltrans District 4 Highway Operations, Traffic volume counts (2000-2004).

Figure 9
Peak Hour Volumes by Ramp – Northbound I-680



Source: Caltrans District 4 Highway Operations, Traffic volume counts (2000-2004).

Traffic Operations

Caltrans monitors freeway conditions by collecting data on the magnitude, extent and duration of congestion. To characterize typical weekday conditions, speed and travel time data were collected using "floating car" runs. Caltrans District 4 summarized conditions for several representative locations on I-580 and I-680 in the *Year 2002 Bay Area Freeway Congestion Data* report. During the AM peak hour, vehicles on westbound I-580 between Vasco Road and Airway Boulevard experienced 3,910 vehicle hours of delay and the congestion lasted for more than three hours (6:15AM – 9:30AM). At El Charro Road vehicles experienced 250 hours of delay, and congestion lasted between 6:45AM and 9:15AM.

Table 3 summarizes congestion delay and duration data.

Table 3
Year 2002 Congestion Delay and Duration

Facility	Direction	Location	Delay (vehicle hours)	Duration
AM Peak Hour				
I-580	WB	Vasco Road to Airway Boulevard	3,910	6:15 – 9:30AM (3 hrs, 15 mins)
I-580	WB	At El Charro Road	350	6:45 – 9:15AM (2 hrs, 30 mins)
I-680	SB	Sunol Road to Route 262	3,600	5:55 – 10:45AM (4 hrs, 50 mins)
PM Peak Hour				
I-580	EB	At Route 84	260	3:35 – 7:05PM (3 hrs, 30 mins)
I-580	EB	Hopyard Road to w/o of El Charro Road	7,040	2:55 – 6:40PM (3 hrs, 45 mins)
I-680	NB	At Scott Creek Road and At Route 262 to Washington	660	3:15 – 6:15PM (3 hours)
I-680	NB	Calaveras Road to Scott Creek Road	810	4:00 – 6:00PM (2 hours)

Source: *Information Memorandum: Year 2002 Bay Area Freeway Congestion Data*, Caltrans District 4, Office of Highway Operations.

Caltrans ranks locations based on delay where there is continuous stop and go conditions. Eastbound I-580 between Hopyard Road and west of El Charro Road during the PM peak hour was ranked number three based on the duration of total delay. Southbound I-680 (AM peak hour) between Sunol Road to south of Route 262 was ranked number eight.

Table 4 summarizes the results of "floating car" runs for I-580 and I-680, representing typical conditions. Each speed profile shows variations in speeds by location for a typical run. It also summarizes, over several runs, travel times for the entire corridor. The travel times and average speeds shown in the table represent conditions with typical levels of congestion as well as conditions with no congestion.

Table 4 shows that travel times when conditions are the most congested are at least twice as long as under free-flow conditions for both I-580 and I-680. Correspondingly, average speeds under congested conditions are about half as fast under free-flow conditions. Close inspection of the speed profiles shows where the variations in speeds occur within each corridor. In the AM peak hour on westbound I-580, speeds begin to decrease east of Greenville Road, dropping to below 10 mph between Vasco Road and Route 84. Speeds continue to stay low until Airway Boulevard. At this point, speeds begin to increase, resulting in free flow conditions through the end of the study area at I-680.

Table 4
Corridor Travel Times and Average Speeds

Highway	Direction	Peak Hour	Travel Time Congested (Free Flow) (minutes)	Avg. Speed Congested (mph)
I-580	EB	PM	42.5 (18.9)	29
I-580	WB	AM	40 (18.7)	30
I-680	NB	PM	37 (19.6)	35
I-680	SB	AM	42 (19.4)	30

Source: Caltrans District 4, Highway Operations, fax from R. Kyutoku, March 28, 2004.
Notes: I-580 speed and travel time data was collected between N. Flynn Road and I-680. I-680 data was collected between Bernal Avenue and Capitol Avenue.
Conditions were considered to be free-flow when average speeds were about 65 mph.

In the eastbound direction during the PM peak hour, speeds decrease briefly east of the I-680 interchange. Speeds then increase but decrease sharply at the Hopyard Road interchange, resulting in stop-and-go conditions. After the Tassajara Road interchange, speeds begin to increase again, continuing until the Livermore Avenue interchange. Speeds decrease as traffic approaches the Route 84 interchange.

On southbound I-680 during the AM peak hour, conditions are generally free flowing or only slightly impeded south of Bernal Avenue until Andrade Road. At this point, speeds decrease and traffic flow becomes unstable. Large variations in speeds, sometimes dropping below 10 mph, continue until Mission Boulevard/Route 262. Traffic flow becomes free-flowing after this point, continuing through the end of the corridor.

In the PM peak hour on northbound I-680, speeds begin to become unstable north of Scott Creek Road where there is a lot of variation. Although traffic flow remains free flowing after Mission Boulevard/Route 262, speeds drop north and south of the truck scales between Sheridan Road and Andrade Road. Speeds then climb back to allow free flow conditions.

The segment between Scott Creek Road and Capitol Expressway was also surveyed in the non-predominant direction during the peak hours (this segment extends beyond the study area). During the PM peak hour in the northbound direction, the speed profile shows speeds fluctuating between 0 and 30 mph between Scott Creek Road and Calaveras Boulevard/Route 237.

Truck Percentage

Caltrans compiles the percentage of trucks on California highways.[9] For I-580 within the study area, the average percentage of trucks on a daily basis was ten percent. For I-680, it was seven percent.

Vehicle Occupancy and Vehicle Classification

Caltrans compiles information on vehicle occupancy for facilities with existing HOV lanes only. Therefore, only data on vehicle occupancy is available for I-680.

Table 5 shows vehicle occupancy and classification data for I-680.

[9] "2002 Annual Average Daily Truck Traffic on the California State Highway System," Caltrans, February 2004.

Table 5
I-680 (Southbound AM) Vehicle Occupancy and Classification

	Peak Period (4)		Peak Hour	
	6:00 to 9:00 AM		7:00 to 8:00 AM	
	HOV Lane	GP Lanes	HOV Lane	GP Lane
Vehicles				
Motorcycles	57	189	23	2
Buses	0	21	0	8
Carpools (1)	989	856	371	495
Vanpools	4	0	1	0
Single Occ. (2)	-	15,040	-	5,323
Violators	48	-	25	-
TOTAL	**1,098**	**15,936**	**420**	**5,828**
Persons				
Motorcycles	57	19	23	2
Buses	0	735	0	280
Carpools (1)	2,008	1,764	764	1,018
Vanpools	40	0	10	0
Single Occ. (2)	-	15,040	-	5,323
Violators	48	-	25	-
TOTAL	**2,153**	**17,558**	**822**	**6,623**
Rates				
HOV Lane Occupancy Rate	2.0 persons/veh		2.0 persons/veh	
GP Lane Occupancy Rate	1.1 persons/veh		1.1 persons/veh	
Overall Occupancy (incl. Buses)	1.2 persons/veh		1.2 persons/veh	
Violation Rate (HOV Lane) (3)	4.4%		6.0%	

Source: "HOV Lanes in the Bay Area," Caltrans District 4, 2002.

Notes:

(1) Two or more persons per vehicle.

(2) General purpose lanes only.

(3) Violation rate = $\frac{\text{no. of violators in HOV lane} \times 100\%}{\text{Total no. of vehicles in HOV lane}}$

(4) HOV lane in operation from 5:00 to 9:00AM

(5) *Observations conducted 12/05/02 at Washington Boulevard I/C*

2.3 Travel Patterns

Interstate 580

In 2000, the San Joaquin Council of Governments (SJCOG) and the San Joaquin Partnership sponsored a study to examine commute patterns in the Altamont Pass region. They surveyed drivers traveling westbound over the Altamont Pass via a mail-in survey. Responses were received from 3,950 drivers. Table 6 shows the results of the survey for drivers.

Table 6
Origins and Destinations by County for Drivers

County	Percent
Trip Origins	
San Joaquin	71
Stanislaus	23
Contra Costa	1
Sacramento	1
Other	3
Trip Destinations	
Alameda	60
Santa Clara	21
Contra Costa	8
San Mateo	3
San Francisco	3
Other	5

Source: "Altamont Pass Commuter Survey," San Joaquin Partnership & San Joaquin Council of Governments, October 2000.

Table 7 provides additional information on destination by city.

Table 7
San Joaquin I-580 Destinations, AM Peak Period, Westbound Drivers

City	Percent
Livermore	16.1
Pleasanton	14.0
San Jose	9.7
Fremont	6.9
Hayward	5.8
Oakland	5.2
San Ramon	5.0
Dublin	4.0
Berkeley	3.6
San Francisco	3.4
Santa Clara	3.3
San Leandro	2.7
Emeryville	2.6
Milpitas	2.4
Sunnyvale	2.1
Mountain View	1.4
Palo Alto	1.3
Newark	1.1
Union City	1.0
Walnut Creek	0.9
Redwood City	0.8

Source: "Altamont Pass Commuter Survey," San Joaquin Partnership and San Joaquin Council of Governments, October 2000.

Interstate 680

Travel in the I-680 corridor is oriented towards jobs in southern Alameda County and Santa Clara County.[10] To find affordable housing, many of these workers reside in southern and eastern Contra Costa County, eastern Alameda County and the San Joaquin Valley. The only major route linking jobs in Silicon Valley with the housing in these areas is the I-680 corridor.

2.4 Transit

Livermore Amador Valley Transit Authority (LAVTA)

This agency operates fixed route, express service and shuttle service in the Tri-Valley area, serving the cities of Dublin, Pleasanton and Livermore. Two bus routes operate on I-580. Route 12X (Livermore Transit Center/Las Positas College/BART) operates express service in both the eastbound and westbound directions during the morning and afternoon via the Dublin-Pleasanton BART station. Route 20X is also connected to the Dublin-Pleasanton BART station. It connects the BART station with Lawrence Livermore National Laboratory. The service operates for about a three-hour period in both the AM and PM peak periods (6:00AM to 9:00AM, 3:00PM to 6:00PM). There are five runs in the morning and six runs in the evening.

Santa Clara Valley Transportation Authority (VTA)

VTA operates four routes that operate on I-680 in southern Alameda County and northern Santa Clara County. All of the routes terminate at the Fremont BART station. Route 180 (Fremont BART – San Jose/Diridon Station) operates seven days a week with half-hour headways in both directions. Two of the routes, Route 520 (Fremont BART-Lockheed Martin/Moffett Park) and Route 140 (Fremont BART-Sunnyvale Caltrain), offer peak hour directional service of six and ten trips a day, respectively. The fourth route (Route 141) offers only weekend and holiday service between Fremont BART and Great America. All of these routes are considered express service.

The County Connection

This transit agency serves central Contra Costa County including the San Ramon Valley. Four of its bus routes serve the Dublin-Pleasanton BART station. To get to the station, these routes use I-580 between I-680 and the Hacienda Boulevard interchange.

Altamont Commuter Express (ACE) Trains

The ACE corridor extends from Stockton in San Joaquin County to San Jose. There are ten stations, including Livermore, Pleasanton and Fremont. There are three morning westbound trains and three afternoon eastbound trains. Average daily ridership in April 2004 was about 1,300 riders. The Livermore station averaged 130 riders and the Pleasanton station averaged 170 riders.[11]

Bay Area Rapid Transit (BART)

This segment of the I-580 corridor is served by the Dublin-Pleasanton BART station. This station is located south of I-680 at Hacienda Boulevard. There is direct service between this station and Daly City. The rest of the BART system is accessible from this line by transferring to other trains at the Bayfair station. The average weekday volume of exits from the Dublin-Pleasanton station is 5,957 exits.[12]

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[10] *I-680 Value Pricing Study Feasibility Study*, Alameda County Congestion Management Agency, 2003.
[11] Phone conversation with ACE Commuter Rail representative, May 3, 2004.
[12] "Quarterly Weekday Average Exits," 4th quarter of fiscal year 2002-03, BART, http://www.bart.gov/docs/stationexits.pdf

Table 8 shows the origins of riders boarding at the Dublin-Pleasanton station.

Table 8
Rider Origins – Dublin Pleasanton Station

City	Percent
PLEASANTON	25.8%
LIVERMORE	21.2%
DUBLIN	15.8%
SAN RAMON	15.8%
TRACY	4.9%
DANVILLE	3.1%
MODESTO	2.8%
STOCKTON	2.2%
OTHER (<=0.01%)	1.8%
Unspecified	1.3%
MANTECA	1.1%
BYRON	0.9%
BRENTWOOD	0.6%
DISCOVER	0.5%
CERES	0.4%
OAKDALE	0.4%
WALNUT CREEK	0.3%
SALIDA	0.2%
SUNOL	0.2%
TURLOCK	0.2%
DIAMOND	0.2%
PITTSBURG	0.2%
SAN LORENZO	0.2%
WESTLEY	0.2%

Source: "Patron Survey," BART, 1998.

For riders boarding at the Dublin-Pleasanton Station, almost 60 percent exit at downtown San Francisco stations. About ten percent of riders exit in downtown Oakland. Another nine percent get off at the other Oakland stations. The remaining 20 percent exit throughout the BART system.[13]

[13] BART station data, March 2004.

3. ALTERNATIVES DEFINITION

This chapter defines the range of potential alternatives for the study. It consists of four sections: (1) Discussion of alternative compensation schemes; (2) uniform characteristics for all alternatives; (3) variable features (major features which will have variations distinct enough to constitute separate consideration and separate travel forecasting runs); and (4) the rationale for selection of alternatives to analyze.

3.1 Alternative Compensation Schemes

The basic notion underlying HOT/C lanes is that revenue from a HOT lane facility could be used to subsidize the travel of those who do not benefit directly from the HOT lane itself. In offering such compensation, the aim is to address the public perception that HOT lanes benefit only travelers who can afford the access. In so doing, the political feasibility of the HOT lane project may be improved. Although a new HOT lane, in fact, benefits all corridor users by increasing capacity and reducing travel times, the perception that HOT lanes are luxury or "Lexus lanes" that selectively benefit the affluent is not uncommon. This is particularly important in places like the Bay Area where the new lanes proposed for I-680 are being paid for by general highway funds, rather than dedication of HOT lane revenues.

There are several ways in which such compensatory cross-subsidies could be implemented. Those remaining in the general purpose lanes could earn: (1) unrestricted cash credits, useable for any purpose; (2) credits that are redeemable only for a variety of transportation services in the corridor; or (3) redeemable only for access to the HOT lane. The unrestricted cash policy makes sense only in the case in which there are no transportation alternatives of value and, in any case, would be extremely difficult to justify to the public and policy-makers. The transportation services policy makes sense only if there are likely to be substantial options to HOT lane that a significant number of travelers can and will use. The third option – redeemable only for HOT lane tolls – is most appropriate for suburban corridors, where park-and-ride parking is free and transit and paratransit options are sparse, due to the highly dispersed patterns of residences and employment centers.

As an empirical matter, the subsidization of the HOT lane trip is the most practical compensation option to model. This is because the GP lane users are, by definition, drivers before the HOT lane is implemented; hence, the closest substitute for their current means of travel is the HOT lane. Paying the HOT lane toll is the most likely use to be made of any cash credit restricted to transportation services by the corridor user. In contrast, the use of the credits to buy down transit fares is unlikely to be empirically important, because transit use is generally inelastic with respect to the level of fares. Similarly, paratransit services, such as taxi or limousine service, also are unlikely to be viewed as a substitute because the out of pocket costs of such service are very high relative to the level of compensation available from the HOT/C policy. This severely limits the influence that the HOT/C subsidies would have on the use of such services, and the impact of such policies will be difficult to detect in a modeling or real-world context.

This logic suggests that the use of HOT/C subsidies to underwrite the tolls for occasional HOT lane trips by GP lane users constitutes a best-case HOT/C policy, from the standpoint of both the fairness and effectiveness of the HOT/C compensation policy. Therefore, on these corridors in the Bay Area policy context, the assumption that credits earned by HOT/C lane users would subsidize HOT lane access is employed in this study.

3.2 Uniform Characteristics for all Alternatives

Because the specific focus of the study is primarily to address equity issues, particularly as they pertain to lower-income corridor users, the focus is on comparing alternatives is on the economic

features -- who receive the "credits," in what form, in what carpool policy context and how much. That requires a consistent "base case" in which other potential variables are held constant. For the purposes of this study, the analysis findings and recommendations arising from the Interstate 680 Variable Pricing Feasibility Study, completed in 2003, were used to inform the base case. That proposal, which has been adopted and is being implemented by the Alameda County Congestion Management Agency (ACCMA) and other local entities, is presumed to be the basic model for both I-680 and I-580 HOT lanes. Uniform assumptions and parameters include that apply to this study:

- The corridor segments for I-680 (approximately 14 miles) is deemed to consist of three GP lanes and one HOV/HOT lane in each direction, and I-580 (approximately 12-13 miles, east and westbound directions respectively) was deemed to consist of four GP lanes and one HOV/HOT lane in each direction. These configurations are consistent with current plans to expand the freeways, and implementation of HOT lanes is contingent upon these improvements. The hours/days of week for HOT lane operation of the designated lanes are the same for all alternatives studied.
- The lane separation treatment would be solid striping, consisting of two sets of yellow lines with a buffer of between two and four feet apart.
- Ingress/egress to the HOT lanes on the I-580 and I-680 corridors would be limited to certain locations and designated by breaks in the solid yellow striping and by signage. Vehicles could enter or exit the HOV/HOT lanes only at designated locations, in both cases at the beginning and end of the HOT lane and at intermediate access locations along the corridor. Access locations were dictated by factors such as traffic demand, distance from key interchanges, and operational and safety considerations. For I-580, intermediate access/egress locations would be at Vasco Road, Isabel Avenue, and Tassajara/Santa Rita Road; for I-680 the intermediate access/egress location would be at Auto Mall Parkway (see **Appendix B** for a more detailed explanation).
- Electronic toll collection would use the Bay Area's existing FasTrak transponders and administrative systems. Application and eligibility for HOT/C lanes credits would also be linked to transponder accounts administration. The toll pricing would be variable in order to maintain free-flow traffic conditions on the HOT lanes. Tolls would be adjusted periodically or "dynamically" (immediately to reflect actual, current traffic conditions) to assure that traffic equilibrium is maintained in the HOT lane.
- Enforcement would be accomplished by enhanced California Highway Patrol (CHP) surveillance and potential new enforcement technologies, including the technologies now being tested on a Minnesota I-394 HOT lane in the Minneapolis region. These technologies would permit a mobile CHP unit to randomly check whether a mobile vehicle in the HOT lane had recently paid a toll.
- Two horizon years available in the MTC model - 2000 and 2025 - were used for travel demand modeling and economic forecasting purposes.
- Crediting rates are the amount of credit received by an eligible vehicle when using the GP lanes. Several different crediting rates are considered in order to maintain high service levels on the HOT lanes and assure that they would not be overwhelmed by vehicles using their credits on the HOT lane. The crediting rates that were analyzed range from 1-in-3 (i.e., two rides in GP lanes provide credit for one free trip on the HOT lane) as the most generous, up to 1-in-51 (50 rides in GP lanes provide credit for one free trip on HOT lane) as the least generous. The user must own and use a valid account and transponder to receive the credit.
- The time of day for HOT/C lanes credit would be the peak periods in the morning and afternoon in both directions.
- Two alternative carpool policies are modeled in the study, namely 2+ and 3+ definitions of carpools. The current policy on most HOV lanes in the region is 2+ are eligible; however,

because the study includes analysis of the long-term future (horizon year 2025), the possibility of eventually moving to the 3+ policy is also considered.

- MTC's definition of "low-income households," 200 percent of the federal poverty level, was adopted.
- As points of comparison, conventional HOV lanes (no tolling, no HOT/C policy) and conventional HOT lanes (no HOT/C policy) were also modeled.

A simple low-income toll discount alternative (i.e., low-income users would pay a lower toll than other users, but there would be no crediting for their use of GP lanes) was briefly considered but discarded, because this alternative was deemed to be outside the scope of the study. Nevertheless, such an alternative may be considered at a later date as a different way to deal with the income equity issue. It is presumed that the low-income toll discount scheme, similar to all of the FAIR lane alternatives (both Limited Eligibility and 100 Percent Eligibility), would have impacts in proportion to the magnitude of the subsidy, because the discount would increase the number of HOT lane users paying a discounted toll. The impacts would be felt in both the revenues and in the performance of the HOT lanes and the GP lanes. One alternative that was also briefly considered but screened out early in the study was tolling the entire I-580 and I-680 corridors, i.e., turning them into complete toll roads on all lanes. This alternative was eliminated due to a lack of adequate, alternate parallel routes in the corridors and the presumed political infeasibility of converting a traditional freeway (with no alternative routes) into a toll road. It is highly unlikely that decision-makers and the public would find this acceptable.

3.3 Variable Features

Variable features for the study include the following.

- **Amount of the credit.** The amount of credit for each use could be a flat amount per trip varying by time of day, or a percentage of the toll at any given time (e.g., if the toll is $3.00 and the crediting rate is 20 percent, then the credit is $0.60). For the sake of streamlining the analysis, the percentage methodology is used. There are several iterations of toll levels, and the most consistent way to test the impact of different tolls is to hold constant the relationship of the credit to the toll. The testing of crediting rates ranges from a modest level to a significant one.
- **Eligibility for credit.** The crediting system considered two different scenarios of who would be eligible for HOT/C Lane credits: (1) only low-income users (defined as 200 percent of federal poverty level income), known as the Limited Eligibility scenarios; (2) all GP lane users, namely 100 percent of those using the GP lanes and who have transponders, known as the 100 Percent Eligibility scenarios. This is a complex and critical variable, because it affects demand and usage on both GP and HOT. For alternatives where only low-income I-580 and I-680 corridor users are selected as the sole recipients of FAIR credits, these credits, or subsidies, would be provided to users of the GP lanes of a freeway that also contains a HOT lane. The credits would be accumulated by the GP lane user, recorded through electronic toll collection equipment, and be useable toward the toll on the HOT lane. For example, if the crediting ratio were 2:1, an eligible GP lane user would earn a "free" trip on the HOT lane by taking two trips on the GP lanes; if the crediting ratio were 10:1, an eligible GP lane user would earn a "free" trip by taking ten trips on the GP lane. Several other crediting rates are used for comparative purposes.
- **Carpool Policy.** Two carpool policies, HOV 2+ and HOV 3+, are studied in conjunction with the above HOT/C credit rates and eligibility criteria.
- **Horizon Years.** To be consistent with MTC modeling capabilities, the years 2000 and 2025 are the horizon years for this study.

3.4 Selection of Alternatives

The objective of selecting alternatives to study is to devise a series of roughly comparable alternatives that meet the primary objective of the study in examining a toll-crediting system as a potential solution to a perceived equity problem. The alternatives need to capture the variables described above and be distinct enough from one another to yield meaningful results to test the HOT/C lanes concept.

The 14 policy scenarios that meet the specific purposes of the study and are comparable in terms of travel and economic forecasting and operational analysis include the following:

Conventional HOV Alternatives

- Scenario A: HOV 2+ carpool policy, no tolling, and no HOT/C credits granted,
- Scenario B: HOV 3+ carpool policy, no tolling, and no HOT/C credits granted

Scenarios A and B provide a base case of a conventional HOV lane for which there is no tolling whatsoever and therefore no economic equity issue arising from tolling. It provides a point of comparison for measures such as vehicle speeds and volumes. It, of course, provides no revenues.

Limited Eligibility HOT/C Alternatives (low-income users only)

- Scenario C: HOV 2+ carpool policy, tolling of SOVs, and low-income SOVs qualify for HOT/C credits at a 1 in 3 trips rate.
- Scenario D: HOV 3+ carpool policy, tolling of SOVs and HOV 2s, and low-income SOVs and HOV 2s qualify for HOT/C credits at a 1 in 3 trips rate.
- Scenario E: HOV 2+ carpool policy, tolling of SOVs, and low-income SOVs qualify for HOT/C credits at a 1 in 11 trips rate.
- Scenario F: HOV 3+ carpool policy, tolling of SOVs and HOV 2s, and low-income SOVs and HOV 2s qualify for HOT/C credits at a 1 in 11 trips rate.

Scenarios C through F examine the impacts of the HOT/C lanes policy. They compare widely varying crediting rates. They also test the impact of 2+ and 3+ carpool policies. These scenarios are the most relevant to the concept of "fairness" as defined by providing a special benefit to low-income corridor users.

100 Percent Eligibility HOT/C Alternatives (all-user eligible, regardless of income)

- Scenario G: HOV 2+ carpool policy, tolling of SOVs, and 100% HOT/C credit eligibility at a 1 in 11 trip rate.
- Scenario H: HOV 3+ carpool policy, tolling of SOVs and HOV 2s, and 100% HOT/C credit eligibility at a 1 in 11 trip rate.
- Scenario I: HOV 2+ carpool policy, tolling of SOVs, and 100% HOT/C credit eligibility at a 1 in 26 trip rate.
- Scenario J: HOV 3+ carpool policy, tolling of SOVs and HOV 2s, and 100% HOT/C credit eligibility at a 1 in 26 trip rate.
- Scenario K: HOV 2+ carpool policy, tolling of SOVs, and 100% HOT/C credit eligibility at a 1 in 51 trip rate.
- Scenario L: HOV 3+ carpool policy, tolling of SOVs and HOV 2s, and 100% HOT/C credit eligibility at a 1 in 51 trip rate.

Scenarios G through L examine the impact of providing a credit to all GP lane users who have a transponder. Drivers are rewarded for using the GP lane and enduring the congestion by allowing them to accumulate credits useable to pay their toll. It does not target low-income users, but instead seeks to make the HOT lane concept more attractive to all corridor users and therefore potentially more acceptable to the general public, because they would always receive a benefit. However, in order to assure free-flow conditions on the HOT lane, the crediting rates are expected to be very low, so the credit may be viewed by many users as almost negligible.

Conventional HOT Lane Alternatives

- Scenario M: HOV 2+ carpool policy, tolling of SOVs and no HOT/C credits.
- Scenario N: HOV 3+ carpool policy, tolling of SOVs and HOV 2s, and no HOT/C credits.

Scenarios M and N represent "pure" HOT lanes and also provide a point of comparison. They provide a "zero credit" to GP lane users of any income and represent the pure HOT lane. They are useful in terms of comparing revenue generation as well as traffic conditions.

4. PUBLIC ACCEPTANCE OF HOT CREDIT LANES AND VALUE-PRICED LANES AS AN EQUITY SOLUTION

"Equity" in the transportation pricing context generally refers to distribution of impacts (benefits and costs) and the degree to which this distribution is considered fair and appropriate. For this study, transportation equity impacts fall into the following two categories.

1. *"Horizontal equity* (also called *fairness* and *egalitarianism*[14]) is concerned with the distribution of impacts between individuals and groups considered equal in ability and need. According to this definition, equal individuals and groups should receive equal shares of resources, bear equal costs, and in other ways be treated the same" (Litman, 2005).

2. *Vertical equity* (also called *social justice*, *environmental justice*[15] and *social inclusion*) with regard to income is concerned with the distribution of impacts between individuals and groups that differ in abilities and needs, in this case, by income or social class. According to this definition, transport policies are equitable if they favor economically and socially disadvantaged groups, therefore compensating for overall inequities (Litman, 2005).

   Horizontal equity often requires that users bear the full costs of their transport facilities and services, but vertical equity often requires subsidies for disadvantaged people. Therefore, transportation planning often involves making tradeoffs between different types of equity.

   Horizontal equity requires that people pay, as much as possible, the costs imposed by their travel activities. Pricing reforms such as road pricing, distance based fees, and fuel tax increases can increase equity by charging according to use, taking into account factors such as vehicle type, time and location.

In order to assess public and stakeholder attitudes towards both the FAIR lanes concept and value-priced HOT lanes, the study team conducted two focus groups with frequent users of I-580 and I-680 and a public opinion survey of residents in Alameda County and the surrounding communities.

4.1 Focus Groups

On August 24, 2004 two focus groups were conducted in Dublin, California. Participants in the groups consisted of Alameda and Contra Costa County residents, as well as residents from the towns of Castro Valley, Dublin, Hayward, Livermore, Pleasanton and San Ramon. All participants were I-580 and I-680 users, and they were screened during the recruiting process to ensure as much diversity in income level and commute patterns as possible. The first group consisted of ten female participants, and the second group consisted of ten male participants. The groups were professionally moderated. The Focus Group Moderator's Guide is **Appendix C**.

Focus groups are qualitative research, not quantitative. To this end, focus groups explore how people talk and think about a specific topic and what is important to them, rather than measuring levels of support for particular points of view or positions. Votes taken within a focus group are not statistically valid, and they may not be representative of the population at large.

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[14] *Egalitarianism* means treating everybody equally, regardless of factors such as race, gender or income.

[15] *Environmental justice* is defined as the "equitable distribution of both negative and positive impacts across racial, ethnic, and income groups, with the environment defined to incorporate ecological, economic, and social effects" (Alsnih and Stoper, 2003).

Summary

The focus groups for the study were designed to further explore and build upon the findings from focus groups that had been conducted for the ACCMA in July of 2003 on the subject of HOT lanes. Those earlier focus groups explored attitudes towards HOT lanes on I-680 over the Sunol Grade and found that participants were generally uncomfortable with the HOT lane concept as presented in those focus groups. In particular, participants were disinclined to accept the congestion relief benefits of HOT lanes and concerned about implementation issues. On a more promising note, participants in these groups expressed strong support for carpooling and carpool lanes and were most likely to support the HOT lane approach because it would finance construction of the northbound carpool lane over Sunol Grade. However, as noted below, the public opinion survey indicated strong support for HOT lanes, but a substantial reduction in support when the HOT/C lanes component is added.

Using those findings as a starting point, the focus groups were designed to present HOT lanes in the context of completing the regional carpool lane network, and to then further test support for the HOT/C lanes concept as a means to address fairness concerns. It should also be noted that the terminology used to describe the concept was modified and labeled as "Smart Carpool Lanes" to be consistent with the revised and publicly-known name of the ongoing I-680 HOT lanes implementation project.

The HOT lanes were described as HOV lanes which single-occupant vehicles (SOVs) could use in exchange for paying a fee, and that the fee would be collected by electronic transponders such as those in use for the region's bridges. There would be striped separation between the HOV lanes and the rest of the freeway. The revenues that would be collected would be used to expand the region's HOV lane network and regional express bus service.

In contrast to the 2003 focus groups, the 2004 participants were generally supportive of the Regional Smart Carpool Lane proposal, a full network of interconnected carpool lanes spanning the region. In the context of an ambitious effort to complete the regional carpool lane network, participants accepted HOT lanes as a fair and reasonable way to pay for completion of the network, strongly suggesting that while Bay Area residents may not be ready to accept HOT lanes primarily as a congestion relief strategy in and of themselves, they are ready to accept them as a means to pay for transportation improvements that they want. The Limited Eligibility HOT/C lanes concept, providing benefits to low-income users, was less popular than was the simple HOT lane with no HOT/C credits. While some participants continued to raise fairness concerns about the Regional Smart Carpool Lane proposal, those concerns do not appear to be equity issues concerned with fairness toward low-income users.

Equity Considerations

Findings

1. Context and presentation are critical.

How HOT lane proposals are framed has an enormous impact on how they are perceived. In the August 2003 focus groups, when HOT lanes were presented as toll roads designed to better utilize carpool lanes, relieve congestion, and give commuters better choices, participants believed that HOT lanes were both unfair (in the sense that rich people could buy their way out of traffic while everyone else was stuck in it) and unworkable. When HOT lanes were presented first as a program to expand carpooling and carpool lanes, with a toll component to pay for the improvements, however, participants were much less concerned about either fairness or implementation issues.

In this context, pricing became largely a non-issue, and perhaps an asset, because participants perceived it as a method to raise money for the completion of the regional carpool lane network. Participants liked the idea that solo drivers paying to drive in the carpool lane could finance the

completion of the regional network of carpool lanes, with an emphasis on revenues generated in a given commute corridor being used to fund improvements in that same corridor area. Once the goal was defined as one that was both desirable and believable, participants were also more open to other arguments for HOT lanes, particularly that it would result in improved and expanded bus service and that it would give commuters better choices.

2. Projects, not congestion pricing, are what people support.

As in the earlier groups, residents and commuters by and large do not understand or accept the concepts of marginal pricing or the dramatic impacts that marginal reductions in traffic have on traffic flow. Nonetheless, they supported the proposal because they wanted to see the carpool lane system completed. While congestion pricing and the physics of traffic flow are abstractions that most participants do not grasp, building carpool lanes are a concrete transportation improvement that participants understand, know that they want, and believe will benefit them. Although this contingency was not tested in the focus groups, it is reasonable to expect that support for HOT lanes would be reduced in the event that revenues were to prove insufficient to help pay for expansion of the carpool lane system.

3. Fairness concerns are not necessarily income equity concerns.

Discussions of fairness did not prompt participants to suggest or volunteer anything like the HOT/C lanes concept. Unfairness as an issue is conceptualized not as a problem of poor people being excluded from the HOT lane. Rather, for a few participants, it was articulated as a way for rich people to "buy" their way out of traffic. In other words, participants weren't concerned that poor people wouldn't be able to use the lanes, they were concerned that <u>they</u> wouldn't be able to use the lanes, because they would be too expensive for them. Making special exemptions or creating special programs for the low-income drivers received virtually no support. If poor people were given a credit, then rich people and poor people could use the lane, but the focus group participants still could not. Participants emphatically disliked the idea of classifying people by income, making statements such as "if it wasn't a class issue before, this would make it one." Even the lower income participants shared the general dislike for HOT/C lanes solutions and discounted tolls, and were among the strongest supporters of the SMART Lanes concept.

In particular, the women in the groups saw the idea of solo drivers paying to use the carpool lane as an issue of choice and control, not unfairness or discrimination. They saw it as something "I would use," and felt it could benefit anyone, especially since traffic relief would be a net benefit for everybody. Furthermore, low-income commuters still have access to the carpool lane by carpooling or taking the bus.

4. Smart Lanes must not be seen as a threat to the carpool lane.

The strongest argument made by participants against the Smart Carpool Lanes concept is not, as might be expected, fairness. Rather, it is the idea that solo drivers will bring the carpool lane to a standstill. Both groups had visions of stalled traffic in carpool lanes as virtually every commuter on the freeway attempted to buy their way into a faster commute. Participants did not imagine, or necessarily believe when the concern was addressed, that pricing of the lane could successfully regulate use and ensure free flowing conditions.

Drivers are already enthusiastic about completing the carpool system throughout the region; they do not need to be talked into it. They are also supportive of expanded and improved bus service, (even though they acknowledge that it would have to be significantly faster, more well-connected, and more convenient for the average commuter to start taking the bus). While HOT lanes are perceived as a reasonable way to fund these popular projects, the proposal must also explicitly assure people that doing so will not lead to congestion in the carpool lanes and a reduced incentive to carpool.

5. Completing the regional carpool lane network is a potent way to introduce HOT lanes to the region

The focus group participants' responses make it clear that the proposal is most attractive if introduced as a carpool lane network, not as a HOT lane network.

6. Efforts to address equity issues should be addressed to opinion leaders, not the general public

Based on the focus group participants' responses, it appears that equity concerns, as they pertain to low-income users, are not particularly important to the public, even though they may be important to some elected officials, transit advocates and social justice activists. Concepts like HOT/C lanes elevate the profile of the fairness issue without actually addressing the concern as the public views it. Fairness concerns appear to be addressed more effectively by emphasizing the ways in which the proposal benefits everyone by increasing carpooling, improving express bus service, and giving commuters more choices.

4.2 Public Opinion Survey

From October 11-14, 2004, the study team conducted a telephone survey of 400 randomly selected Alameda County residents. The public opinion survey was conducted by trained, professional interviewers by telephone and it has a margin of error of $\pm$ 4.9 percentage points. The questionnaire and results for the survey is **Appendix D**.

Findings

Alameda County residents strongly favor completion of a Bay Area area-wide regional Smart Carpool Lane system, issues of fairness notwithstanding.

Support for the proposal is driven by continuing concern about traffic – traffic is volunteered by 27 percent of respondents as the number one problem in the county – and the high regard in which residents hold carpool lanes – 91 percent of surveyed county residents have a favorable opinion of carpool lanes.

Prior to testing a specific description of the Smart Carpool Lanes concept, the survey tested potential names for the project. Of these, Express Lanes (68 percent favorable, 10 percent unfavorable) and Smart Carpool Lanes (54 percent favorable, 10 percent unfavorable) were most well received. HOT/C lanes (25 percent favorable, 19 percent unfavorable) and High Occupancy Toll Lanes (40 percent favorable, 33 percent unfavorable) were received far less favorably.

Respondents were then read the following description of a regional Smart Carpool Lane system:

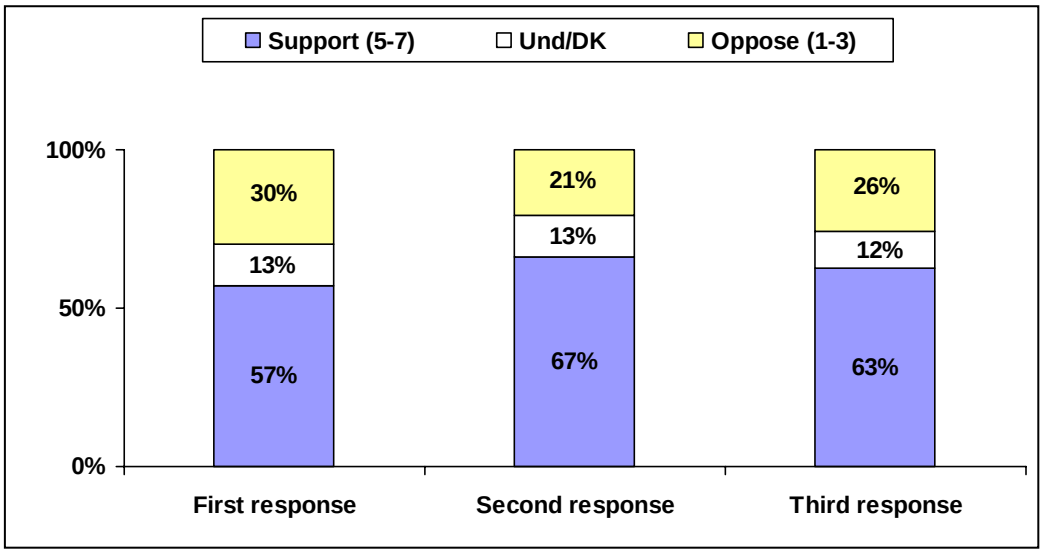
> "There is a proposal under consideration to create a regional Smart Carpool Lane system that would complete and connect carpool lanes on every major highway in the nine county Bay Area region and significantly expand the regional express bus network to utilize the complete system of carpool lanes and provide frequent and reliable express bus service that won't get stuck in traffic. The system would be financed by allowing people who drive alone to use the Smart Carpool lanes for a fee using the same FasTrak pass currently used to pay tolls on Bay Area bridges."

Based upon this description, 57 percent supported the project, 30 percent opposed the project, and 13 percent remained neutral or undecided (see Figure 10). Respondents were then asked about specific elements of the proposal. The strongest elements tested were completing the regional carpool lane system, providing frequent express bus service, and continuing to encourage carpools (which would still use the lanes for free), all garnering support from 75 percent or more of Alameda

County residents. It is important to note, however, that all of the elements of the proposal, including allowing solo drivers to use carpool lanes for a fee, were supported by significant majorities of residents, with all elements of the proposal receiving over 50 percent support and no element seeing opposition from as much as 40 percent of County residents. After hearing about the individual elements of the Smart Carpool Lanes proposal, support for the overall proposal increased by 10 to 67 percent.

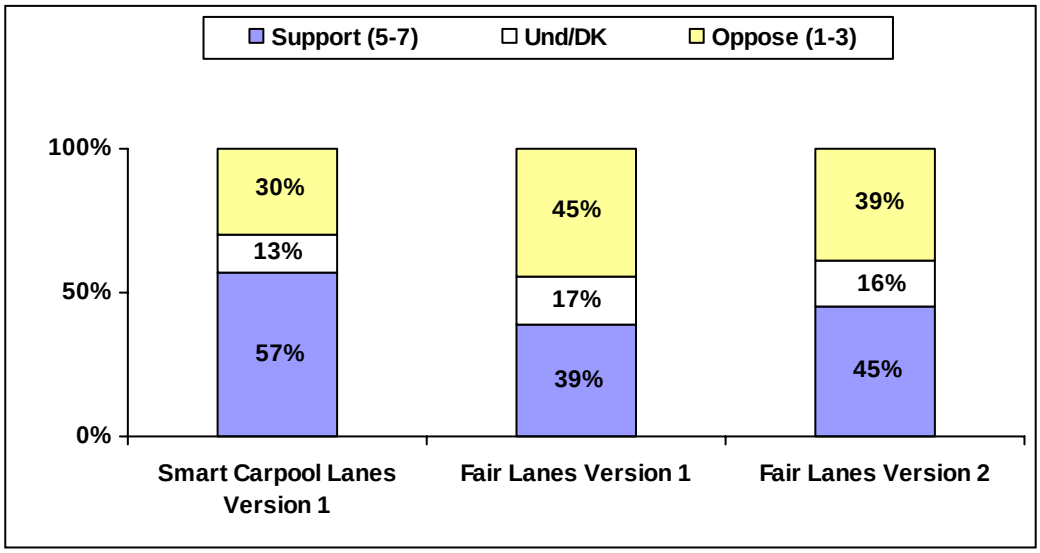
Respondents were then given additional information about Smart Carpool Lanes, both positive and negative. Examples of positive statements include: "A guarantee of a minimum speed" and "Better separation of HOV lanes from the rest of the roadway." Examples of negative statements include: "Allow rich people to buy their way out of traffic" and "Cost too much for poor people to use them." After hearing more information, support declined to 63 percent who said they were "more likely to support." However, it should be noted that this is still six percent higher than the initial level of support. The survey then asked respondents about several proposals to address concerns about fairness. The first was a system of earned credits for solo-driver low-income drivers to use the carpool lane for a fee (the Limited Eligibility concept). As illustrated in Figure 11, this proposal garnered more opposition than support, with 39 percent supporting the proposal and 45 percent opposing it.

Figure 10
Alameda County Residents' Opinion of SMART Lanes



Source: Evans/McDonough Company, Inc., 2004.
Note: Responses are based on a 1 to 7 scale where 1 is "Strongly Oppose" and 7 is "Strongly Support".

Figure 11
Alameda County Residents' Opinion of Fairness Proposals



Source: Evans/McDonough Company, Inc., 2004.
Note: Responses are based on a 1 to 7 scale where 1 is "Strongly Oppose" and 7 is "Strongly Support".

The second proposal would simply give a discount on the toll to solo-driver low-income people who want to use the carpool lane. While this proposal received more support (45 percent support, 39 percent opposition) it is important to note that both proposals were significantly less popular among Alameda County residents than was the Smart Carpool Lane proposal initially tested in the survey. It is also important to note that these findings are consistent across all income levels. While low-income residents are slightly more supportive of the two FAIR lanes proposals tested and slightly less supportive of the Smart Carpool Lane proposal, they are still significantly more supportive of the Smart Carpool Lane proposal than they are of either crediting proposal.

Conclusions

Findings from both the focus group research and the public opinion survey suggest that the single most important factor determining support or opposition to Smart Carpool Lanes is the context in which they are presented to the public. When presented as a toll lane, designed to manage congestion, give commuters choices, and fully utilize carpool lanes, Alameda County residents are generally skeptical. When presented as a carpool lane with a revenue enhancing element designed to deliver desirable transportation improvements, most notably completing carpool lanes and expanding express bus service, residents strongly support the idea. Once a desirable context is set, residents are much more likely to accept and embrace the other beneficial outcomes of the project (e.g., more choices, congestion relief, and full utilization of the carpool lane).

The research strongly suggests that concerns about income equity are not a major determinative factor in public acceptance of Smart Carpool Lanes. To the degree that "fairness" is an issue at all, it is defined as a concern that the wealthy would be able to buy their way out of traffic rather than that the poor would not be able to buy their way into the lane. For the average resident, allowing poor residents into the lanes for a discount only makes the plan less equitable, as it appears that exceptions are being made for everyone but them. Most importantly, the research suggests that most Alameda County residents are willing to accept that not everyone will be able to access the Smart Carpool Lanes if the outcome is a better transportation system for all.

5. HOT CREDIT POLICY MODELING RESULTS

In this chapter the economic and performance impacts of various policy scenarios are analyzed, including both Limited Eligibility and 100 Percent Eligibility HOT/C lanes schemes. Specifically, the effects of HOT/C policy scenarios are measured on speeds, volumes, travel times and toll revenues. These results are derived by implementing ECONorthwest's Toll Optimization Model (TOM©)—a special model designed to determine equilibrium toll levels and lane volumes in the presence of HOT lane type tolling.

The methodology for the forecasting of HOT/C lanes followed a two-phase approach that included both travel demand modeling and economic/performance analysis. The first phase, travel demand modeling, provided input to the economic analysis; this phase defined the alternatives with the uniform features and assumptions described in Chapter 3 (Alternatives Definition) and also defined the exact access locations. A complete description of the travel demand modeling methodology is found in **Appendix B**. The second phase, the economic and performance analysis, resulted in toll structures that were tested using the demand model. The remainder of this chapter presents the results of that analysis.

5.1 Modeling Approach

The modeling of HOT/C policy impacts for both Limited Eligibility and 100 Percent Eligibility requires developing a consistent means of characterizing HOT/C policy and implementing that characterization in the regional and TOM models. The general approach is as follows:

1. HOT/C policy is defined by linking GP lane volumes to the number of vehicles that will gain access to the HOT lane as HOT/C users. This is achieved by defining a HOT/C Crediting Rate that is equal to the number of GP lane trips that it takes for an eligible user to earn a free HOT lane trip. For example, if a user would earn one free HOT lane access credit trip for every two GP lane trips, this is identified as a "1 in 3" HOT lane crediting policy. Hence, the number of HOT/C vehicles in the HOT lane at any given time would be a fraction of the total facility volumes of eligible vehicles.

2. The total number of HOT lane credits that would be redeemed during a given peak period depends on the Crediting Rate and the volume of traffic associated with the eligible users. In this analysis, two different eligibility criteria are examined. The first employs a Limited Eligibility approach, wherein only vehicles associated with defined low-income households are eligible to earn HOT/C lane credits. The ceiling income in this policy is twice (200 percent) the official poverty income level set by the federal government, which is the standard definition used by the San Francisco Bay Area's Metropolitan Transportation Commission (MTC) in its modeling and other research. When making projections over time, it is assumed that the share of such eligible vehicles in the traffic stream remains constant. The share of qualifying vehicles under the poverty criterion was derived from 2000 US Census data.

3. The second eligibility approach assumes that all vehicles in the GP lanes in the corridor are eligible to receive credit towards a future use of the HOT lane. This is referred to as the 100 Percent Eligibility policy. This is the approach that addresses the proposition that all facility users, not only those with low-income, should derive some benefit from HOT lanes, even on those occasions when they do not use them.

4. There are two definitions of HOT/C eligibility and four different assumed Crediting Rates. In addition, there are two variations of each policy under two different assumptions about prevailing carpools-ride-free policy: 2+ versus 3+ occupants, as the definition of a carpool. Finally, there are two additional reference alternatives for comparative purposes: (1) a No

Toll alternative, essentially, a pure HOV lane policy in which carpools go for free and no other vehicles are allowed; and (2) a pure HOT Lane alternative (with no HOT/C policy overlay), where carpools go for free and all non-carpools must pay a toll. Each of these alternatives is also modeled under the two carpool definition policy alternatives, 2+ and 3+. A total of 14 policy scenarios reflecting these variables, labeled A to N, are modeled.

For each of the toll alternatives, tolls are optimized using the TOM model. Toll optimization can be performed to achieve a variety of different performance objectives. In this case, toll optimization is guided by revenue maximization. Optimizing HOT lane tolls with the objective of toll revenue maximization tends to result in slightly lower HOT lane volumes than some other objectives, such as a policy of setting tolls to exactly satisfy a minimum level of service (LOS) criterion. Revenue maximization is particularly appropriate, however, to settings in which the dual goals of maintaining adequate service levels and generating revenue to fund the facility are both important. HOT lane toll revenue potential falls sharply with even small reductions in the level of service. This is especially appropriate in the California policy context wherein 2+ carpools generally are able to use an HOV facility for free, thus limiting the amount of capacity to sell under a HOT lane policy.

Tolls are optimized for individual links or tolled segments of the facility, on the assumption that tolls must be allowed to vary link by link to properly optimize tolls across variable load conditions. A constant toll per mile policy would yield, undesirably, both lower revenues and more variable levels of service from segment to segment of the HOT lane. The toll optimization process is "seeded" using segment level data, and vehicle mixes, derived from MTC's regional travel demand model, as implemented by the study team.[16] Only the AM peak is modeled explicitly, because that is the only diurnal period modeled by the MTC regional model. Separate runs were performed for the years 2000 and 2025.

The effects of likely real income growth in determining the nominal, current (2004) value of the optimal tolls are also incorporated. The purpose of doing so is to correct for the compression in the income distribution that occurs in future years in the regional travel demand model. Specifically, most regional travel demand models, including the MTC model, implicitly assume that value of time increases only at the general rate of inflation. Since the models also assume fixed quartiles of the income distribution, this means that the household income rendered in the regional model tends to compress users into the higher income categories progressively over time. The effect of this is to narrow the income distribution unrealistically. In fact, however, regional incomes tend to grow in real terms, after inflation adjustment and, thus, so do values of time. Hence, the income distribution tends to maintain a greater spread over time than the regional models implicitly recognize. For HOT lane analysis in general, and HOT/C policy in particular, it is important to portray the distribution of incomes and values of time as accurately as possible; therefore, real income is considered in the toll optimization modeling.

The effect of assuming real income growth in the TOM analysis is that tolls per mile are somewhat higher than they would be if this trend in income were ignored. For the purposes of revenue estimation, this effect can be ignored, if desired, to impart extra conservatism regarding facility revenue prospects. However, in the analysis of alternative HOT/C policies, the failure to include real income effects may cause the impact of HOT/C policy alternatives in future years to be mismeasured. Consequently, this effect is included in the HOT/C policy analysis. This effect is removed, for conservatism, in the projections of revenue estimates over a 20-year period.

In other implementations of the TOM model, the tolls derived from the seed run are fed back to the regional model for further refinement. In this case, due to the large number of alternatives being modeled and the policy comparisons that are the focus of the study, no feedbacks to the regional

[16] The regional model runs which were utilized by ECONorthwest were received on 9/20/2004 (2025 run) and 10/15/2004 (2000 run) from Dowling and Associates

model were employed. Such feedbacks would affect absolute toll levels, volumes and speeds to some degree, but would not alter the relative performance of the various HOT/C policy alternatives. Given the purpose of the research, the cost associated with so many additional runs, and the inherent natural "noise" in the regional model equilibration process, avoidance of the feedback process is a reasonable compromise. In Chapter 6, where total 20-year revenues are estimated, the impact of the feedback process on aggregate revenues is estimated for sketch planning purposes.

5.2 Analysis of Alternatives

In this section, model results for 14 different policies affecting the HOT lane performance are presented in the base year, 2000, and 2025. The policy scenarios investigated are as follows:

Conventional HOV Alternatives

- Scenario A: HOV 2+ carpool policy, no tolling, and no HOT/C credits granted,
- Scenario B: HOV 3+ carpool policy, no tolling, and no HOT/C credits granted

Limited Eligibility HOT/C Alternatives

- Scenario C: HOV 2+ carpool policy, tolling of SOVs, and low-income SOVs qualify for HOT/C credits at a 1 in 3 trips rate.
- Scenario D: HOV 3+ carpool policy, tolling of SOVs and HOV 2s, and low-income SOVs and HOV 2s qualify for HOT/C credits at a 1 in 3 trips rate.
- Scenario E: HOV 2+ carpool policy, tolling of SOVs, and low-income SOVs qualify for HOT/C credits at a 1 in 11 trips rate.
- Scenario F: HOV 3+ carpool policy, tolling of SOVs and HOV 2s, and low-income SOVs and HOV 2s qualify for HOT/C credits at a 1 in 11 trips rate.

100 Percent Eligibility HOT/C Alternatives

- Scenario G: HOV 2+ carpool policy, tolling of SOVs, and 100% HOT/C credit eligibility at a 1 in 11 trip rate.
- Scenario H: HOV 3+ carpool policy, tolling of SOVs and HOV 2s, and 100% HOT/C credit eligibility at a 1 in 11 trip rate.
- Scenario I: HOV 2+ carpool policy, tolling of SOVs, and 100% HOT/C credit eligibility at a 1 in 26 trip rate.
- Scenario J: HOV 3+ carpool policy, tolling of SOVs and HOV 2s, and 100% HOT/C credit eligibility at a 1 in 26 trip rate.
- Scenario K: HOV 2+ carpool policy, tolling of SOVs, and 100% HOT/C credit eligibility at a 1 in 51 trip rate.
- Scenario L: HOV 3+ carpool policy, tolling of SOVs and HOV 2s, and 100% HOT/C credit eligibility at a 1 in 51 trip rate.

Conventional HOT Lane Alternatives

- Scenario M: HOV 2+ carpool policy, tolling of SOVs and no HOT/C credits.
- Scenario N: HOV 3+ carpool policy, tolling of SOVs and HOV 2s, and no HOT/C credits.

The HOT/C credit qualifying criteria for the Limited Eligibility alternatives (Scenarios C – F) enables members of low-income households with an annual income at or below 200 percent of the federal poverty level the ability to earn credits as they travel in the corridor. This corresponds to an annual household income of approximately $34,500 for a family of four in 2004.

Data on the distribution of household income among commuters on both I-580 and I-680 were compiled and analyzed using the 2000 Census. The data produced indicates that approximately ten percent of vehicles traveling on I-580 and six percent of vehicles traveling on I-680 would qualify for HOT/C credits at the 200 percent of poverty standard. The modeling work performed for alternatives C – F incorporates these assumptions. It should be noted that these corridors were selected due to active consideration of HOT lanes implementation; however, they are relatively affluent corridors and characterized by a low number of low-income users. Other corridors in the San Francisco Bay Area region may have higher percentages of low-income users.

Scenarios G-L examine the 100 Percent Eligibility scheme, using three different crediting rates and two horizon years. As in all other scenarios, carpools are assumed able to use the HOT lane for free at all times, while non-carpool vehicles may pay a toll to access the HOT lane if they have not accrued enough credits to qualify them for a free trip on the HOT lane.

5.3 Users' Value of Time

Most researchers suggest that travelers generally value their travel time at approximately 60 percent of their hourly wage. For this analysis, the average value of time estimates used in the MTC model and information on real income growth and the variation in household income were used to estimate the distribution of values of time in each vehicle class in the two model years (2000 and 2025). Table 9 shows the mean values of time that were assumed for different vehicle classes. Vehicles' values of time are assumed to grow at a rate tied to real income growth (which is assumed to be 1.8 percent per year) and inflation (assumed to be three percent per year). Note that HOV time values are not a simple multiple of SOV values because households with somewhat different income characteristics tend to form carpools.

Volume-Delay Functions

The TOM analysis employs the same volume-delay function (VDF) specifications, by segment and/or lane as are specified in the regional model. It is important to note that VDF-based models necessarily abstract from the complexities of queuing delays, merge turbulence, and other phenomena that may affect the performance of the facility in actual practice.

Table 9
Mean Values of Time per Vehicle-Hour by Vehicle Class

	VoT from MTC Model (in 1990 in 1990 Dollars)	VoT Used in Toll Modeling (in 2000 in 2004 Dollars)	VoT Used in Toll Modeling (in 2025 in 2004 Dollars)
SOV (includes Light Trucks)	$ 10.96	$ 19.82	$ 30.95
HOV2	$ 19.31	$ 34.91	$ 54.53
HOV3+	$ 28.96	$ 52.37	$ 81.80
Heavy Trucks	$ 22.00	$ 39.78	$ 62.13
Note:			
Annual Real Income Growth:	1.8%		
Annual Infaltion Rate:	3.0%		

Source: ECONorthwest, 2005.

5.4 Results for 2-Hour AM Peak Period in 2000 and 2025

The types of data generated by the Toll Optimization Model are:

- Tolls and revenues, by segment
- Speeds, by lane and link
- Traffic volumes, by lane and link, and by type of user

To summarize this data, average tolls, speeds, total delay (vehicle hours traveled [VHT]) and traffic volumes on each freeway have been calculated and are presented in Tables 10 to 17. More detailed, link level data for individual alternatives is available from the model but not tabulated here. It should be noted that HOT lane facility lengths reported in these tables are calculated from the constituent segment lengths as represented in the MTC model; the actual lengths of an implemented facility are slightly different. These data, along with information on capital and operating costs, allows measurement of the impact of various HOT/C policies. Specifically, we can measure the impact (per HOT/C user of the HOT lane) on toll revenue, total delay (VHT) and capital and operating costs. Table 18 summarizes these impacts for the various HOT/C policy alternatives.

Table 10
Average Toll and Hourly Revenue Estimates during 2-Hour AM Peak Period in 2000 (in 2004 Dollars)

Scenario	Carpool Policy		I-680 South Bound	I-680 North Bound	I-580 West Bound	I-580 East Bound	Total
		No Tolling/No HOT/C Policy					
A	HOV 2+	Hourly Revenue	$ -	$ -	$ -	$ -	$ -
		Average Toll/Mile	$ -	$ -	$ -	$ -	$ -
B	HOV 3+	Hourly Revenue	$ -	$ -	$ -	$ -	$ -
		Average Toll/Mile	$ -	$ -	$ -	$ -	$ -
		Limited Eligibility, 1 in 3 Rides Free					
C	HOV 2+	Hourly Revenue	$ 4,153	$ 42	$ 142	$ 4	$ 4,341
		Average Toll/Mile	$ 0.48	$ 0.01	$ 0.05	$ 0.00	$ 0.14
D	HOV 3+	Hourly Revenue	$ 8,183	$ 84	$ 880	$ 16	$ 9,163
		Average Toll/Mile	$ 0.72	$ 0.01	$ 0.11	$ 0.00	$ 0.23
		Limited Eligibility, 1 in 11 Rides Free					
E	HOV 2+	Hourly Revenue	$ 4,589	$ 46	$ 214	$ 6	$ 4,856
		Average Toll/Mile	$ 0.50	$ 0.01	$ 0.06	$ 0.00	$ 0.15
F	HOV 3+	Hourly Revenue	$ 8,848	$ 90	$ 1,048	$ 19	$ 10,005
		Average Toll/Mile	$ 0.75	$ 0.01	$ 0.12	$ 0.00	$ 0.24
		100% Eligibility, 1 in 11 Rides Free					
G	HOV 2+	Hourly Revenue	$ 2,240	$ 25	$ 69	$ 0	$ 2,335
		Average Toll/Mile	$ 0.37	$ 0.01	$ 0.01	$ 0.00	$ 0.11
H	HOV 3+	Hourly Revenue	$ 5,211	$ 58	$ 517	$ 8	$ 5,794
		Average Toll/Mile	$ 0.58	$ 0.01	$ 0.10	$ 0.00	$ 0.19
		100% Eligibility, 1 in 26 Rides Free					
I	HOV 2+	Hourly Revenue	$ 3,604	$ 37	$ 124	$ 3	$ 3,769
		Average Toll/Mile	$ 0.45	$ 0.01	$ 0.04	$ 0.00	$ 0.14
J	HOV 3+	Hourly Revenue	$ 7,317	$ 77	$ 854	$ 15	$ 8,263
		Average Toll/Mile	$ 0.67	$ 0.01	$ 0.11	$ 0.00	$ 0.22
		100% Eligibility, 1 in 51 Rides Free					
K	HOV 2+	Hourly Revenue	$ 4,153	$ 42	$ 180	$ 5	$ 4,380
		Average Toll/Mile	$ 0.47	$ 0.01	$ 0.05	$ 0.00	$ 0.15
L	HOV 3+	Hourly Revenue	$ 8,165	$ 84	$ 988	$ 18	$ 9,255
		Average Toll/Mile	$ 0.72	$ 0.01	$ 0.12	$ 0.00	$ 0.23
		Tolling + No HOT/C Policy					
M	HOV 2+	Hourly Revenue	$ 4,757	$ 47	$ 246	$ 7	$ 5,058
		Average Toll/Mile	$ 0.50	$ 0.01	$ 0.06	$ 0.00	$ 0.16
N	HOV 3+	Hourly Revenue	$ 9,106	$ 92	$ 1,135	$ 21	$ 10,354
		Average Toll/Mile	$ 0.77	$ 0.01	$ 0.12	$ 0.00	$ 0.25

Source: ECONorthwest, 2005.
Note: Revenues and tolls are in 2004 dollars and include assumed annual real income growth of 1.8 percent.

Table 11
Average Toll and Hourly Revenue Estimates during 2-Hour AM Peak Period in 2025
(in 2004 Dollars)

Scenario	Carpool Policy		I-680 South Bound	I-680 North Bound	I-580 West Bound	I-580 East Bound	Total
		No Tolling/No HOT/C Policy					
A	HOV 2+	Hourly Revenue	$ -	$ -	$ -	$ -	$ -
		Average Toll/Mile	$ -	$ -	$ -	$ -	$ -
B	HOV 3+	Hourly Revenue	$ -	$ -	$ -	$ -	$ -
		Average Toll/Mile	$ -	$ -	$ -	$ -	$ -
		Limited Eligibility, 1 in 3 Rides Free					
C	HOV 2+	Hourly Revenue	$ 8,733	$ 813	$ 1,331	$ 104	$ 10,981
		Average Toll/Mile	$ 0.99	$ 0.14	$ 0.37	$ 0.04	$ 0.41
D	HOV 3+	Hourly Revenue	$ 17,767	$ 1,855	$ 8,732	$ 489	$ 28,843
		Average Toll/Mile	$ 1.51	$ 0.23	$ 0.87	$ 0.08	$ 0.70
		Limited Eligibility, 1 in 11 Rides Free					
E	HOV 2+	Hourly Revenue	$ 9,661	$ 902	$ 2,115	$ 169	$ 12,848
		Average Toll/Mile	$ 1.03	$ 0.15	$ 0.46	$ 0.05	$ 0.45
F	HOV 3+	Hourly Revenue	$ 19,209	$ 2,000	$ 10,439	$ 597	$ 32,245
		Average Toll/Mile	$ 1.59	$ 0.24	$ 0.92	$ 0.08	$ 0.74
		100% Eligibility, 1 in 11 Rides Free					
G	HOV 2+	Hourly Revenue	$ 4,629	$ 423	$ 413	$ 5	$ 5,470
		Average Toll/Mile	$ 0.78	$ 0.11	$ 0.08	$ 0.02	$ 0.27
H	HOV 3+	Hourly Revenue	$ 11,298	$ 1,191	$ 5,030	$ 249	$ 17,767
		Average Toll/Mile	$ 1.21	$ 0.19	$ 0.76	$ 0.06	$ 0.58
		100% Eligibility, 1 in 26 Rides Free					
I	HOV 2+	Hourly Revenue	$ 7,554	$ 699	$ 1,176	$ 92	$ 9,521
		Average Toll/Mile	$ 0.94	$ 0.13	$ 0.35	$ 0.04	$ 0.39
J	HOV 3+	Hourly Revenue	$ 15,877	$ 1,663	$ 8,448	$ 463	$ 26,450
		Average Toll/Mile	$ 1.42	$ 0.21	$ 0.87	$ 0.08	$ 0.67
		100% Eligibility, 1 in 51 Rides Free					
K	HOV 2+	Hourly Revenue	$ 8,728	$ 812	$ 1,748	$ 139	$ 11,427
		Average Toll/Mile	$ 0.99	$ 0.14	$ 0.43	$ 0.05	$ 0.42
L	HOV 3+	Hourly Revenue	$ 17,720	$ 1,850	$ 9,804	$ 546	$ 29,920
		Average Toll/Mile	$ 1.51	$ 0.23	$ 0.91	$ 0.08	$ 0.71
		Tolling + No HOT/C Policy					
M	HOV 2+	Hourly Revenue	$ 10,018	$ 936	$ 2,450	$ 196	$ 13,600
		Average Toll/Mile	$ 1.05	$ 0.15	$ 0.49	$ 0.05	$ 0.46
N	HOV 3+	Hourly Revenue	$ 19,768	$ 2,055	$ 11,291	$ 638	$ 33,751
		Average Toll/Mile	$ 1.62	$ 0.24	$ 0.96	$ 0.08	$ 0.76

Source: ECONorthwest, 2005.
Note:
1. Revenues and tolls are in 2004 dollars and include assumed annual real income growth of 1.8 percent.

Table 12
Average Speeds on the General Purpose and HOT Lane during 2-Hour AM Peak Period in 2000

Scenario	Carpool Policy		I-680 South Bound	I-680 North Bound	I-580 West Bound	I-580 East Bound
		No Tolling/No HOT/C Policy				
A	HOV 2+	GP Speed (mph)	18.3	58.5	51.5	64.0
		HOT Speed (mph)	61.0	61.1	64.0	65.0
B	HOV 3+	GP Speed (mph)	13.5	57.3	43.4	63.4
		HOT Speed (mph)	61.1	61.1	65.0	65.0
		Limited Eligibility, 1 in 3 Rides Free				
C	HOV 2+	GP Speed (mph)	27.3	59.6	54.9	64.3
		HOT Speed (mph)	55.4	61.0	60.1	64.8
D	HOV 3+	GP Speed (mph)	23.1	59.2	52.0	64.2
		HOT Speed (mph)	59.9	61.1	64.2	64.9
		Limited Eligibility, 1 in 11 Rides Free				
E	HOV 2+	GP Speed (mph)	26.8	59.6	54.5	64.3
		HOT Speed (mph)	56.2	61.0	61.2	64.8
F	HOV 3+	GP Speed (mph)	22.4	59.1	51.4	64.1
		HOT Speed (mph)	60.2	61.1	64.5	65.0
		100% Eligibility, 1 in 11 Rides Free				
G	HOV 2+	GP Speed (mph)	29.7	59.8	56.1	64.4
		HOT Speed (mph)	50.9	60.8	54.9	64.6
H	HOV 3+	GP Speed (mph)	26.2	59.5	53.3	64.2
		HOT Speed (mph)	57.2	61.0	63.1	64.9
		100% Eligibility, 1 in 26 Rides Free				
I	HOV 2+	GP Speed (mph)	27.9	59.7	54.9	64.3
		HOT Speed (mph)	54.4	60.9	59.9	64.8
J	HOV 3+	GP Speed (mph)	23.9	59.3	52.1	64.2
		HOT Speed (mph)	59.3	61.1	64.2	64.9
		100% Eligibility, 1 in 51 Rides Free				
K	HOV 2+	GP Speed (mph)	27.3	59.6	54.7	64.3
		HOT Speed (mph)	55.5	61.0	60.7	64.8
L	HOV 3+	GP Speed (mph)	23.1	59.2	51.7	64.1
		HOT Speed (mph)	59.9	61.1	64.4	65.0
		Tolling + No HOT/C Policy				
M	HOV 2+	GP Speed (mph)	26.6	59.6	54.3	64.3
		HOT Speed (mph)	56.5	61.0	61.5	64.8
N	HOV 3+	GP Speed (mph)	22.1	59.1	51.1	64.1
		HOT Speed (mph)	60.3	61.1	64.6	65.0

Source: ECONorthwest, 2005.

Table 13
Average Speeds on the General Purpose and HOT Lane during 2-Hour AM Peak Period in 2025

Scenario	Carpool Policy		I-680 South Bound	I-680 North Bound	I-580 West Bound	I-580 East Bound
		No Tolling/No HOT/C Policy				
A	HOV 2+	GP Speed (mph)	15.7	43.5	28.8	54.9
		HOT Speed (mph)	61.0	61.0	60.6	64.7
B	HOV 3+	GP Speed (mph)	11.2	37.4	19.0	49.8
		HOT Speed (mph)	61.1	61.1	65.0	65.0
		Limited Eligibility, 1 in 3 Rides Free				
C	HOV 2+	GP Speed (mph)	23.8	49.4	34.6	57.6
		HOT Speed (mph)	54.2	59.2	47.1	62.1
D	HOV 3+	GP Speed (mph)	19.7	46.5	29.4	55.9
		HOT Speed (mph)	59.6	60.7	61.5	64.3
		Limited Eligibility, 1 in 11 Rides Free				
E	HOV 2+	GP Speed (mph)	23.3	49.1	33.8	57.2
		HOT Speed (mph)	55.1	59.4	50.5	62.8
F	HOV 3+	GP Speed (mph)	19.0	46.0	28.4	55.5
		HOT Speed (mph)	60.0	60.8	62.8	64.5
		100% Eligibility, 1 in 11 Rides Free				
G	HOV 2+	GP Speed (mph)	26.2	50.7	37.0	58.3
		HOT Speed (mph)	48.6	57.7	35.8	59.8
H	HOV 3+	GP Speed (mph)	22.7	48.4	31.6	56.9
		HOT Speed (mph)	56.3	60.0	57.0	63.4
		100% Eligibility, 1 in 26 Rides Free				
I	HOV 2+	GP Speed (mph)	24.4	49.7	34.8	57.6
		HOT Speed (mph)	52.9	58.9	46.2	62.0
J	HOV 3+	GP Speed (mph)	20.5	47.0	29.6	56.0
		HOT Speed (mph)	59.0	60.6	61.2	64.2
		100% Eligibility, 1 in 51 Rides Free				
K	HOV 2+	GP Speed (mph)	23.8	49.4	34.1	57.3
		HOT Speed (mph)	54.2	59.2	49.1	62.7
L	HOV 3+	GP Speed (mph)	19.6	46.4	28.8	55.8
		HOT Speed (mph)	59.6	60.7	62.3	64.4
		Tolling + No HOT/C Policy				
M	HOV 2+	GP Speed (mph)	23.1	49.0	33.5	57.1
		HOT Speed (mph)	55.5	59.5	51.6	63.0
N	HOV 3+	GP Speed (mph)	18.7	45.8	28.0	55.5
		HOT Speed (mph)	60.2	60.8	63.2	64.5

Source: ECONorthwest, 2005.

Table 14
Summary of Average Vehicle Volumes on HOT Lane during 2-Hour AM Peak Period in 2000

Scenario	Carpool Policy		I-680 South Bound	I-680 North Bound	I-580 West Bound	I-580 East Bound
		No Tolling/No HOT Credit (HOT/C) Policy				
A	HOV 2+	Average Number of HOT/C Vehicles (free trips) on the HOT Lane/Hour	-	-	-	-
		Average Number of Carpool Vehicles Using HOT Lane/Hour	572	383	791	408
		Average Number of Paying Vehicles on the HOT Lane/Hour	-	-	-	-
		Average HOT Lane Volume/Hour	572	383	791	408
		Average GP Volume/Hour	6,569	3,394	5,629	3,765
B	HOV 3+	Average Number of HOT/C Vehicles (free trips) on the HOT Lane/Hour	-	-	-	-
		Average Number of Carpool Vehicles Using HOT Lane/Hour	125	110	145	106
		Average Number of Paying Vehicles on the HOT Lane/Hour	-	-	-	-
		Average HOT Lane Volume/Hour	125	110	145	106
		Average GP Volume/Hour	7,016	3,668	6,275	4,067
		Limited Eligibility, 1 in 3 Rides Free				
C	HOV 2+	Average Number of HOT/C Vehicles (free trips) on the HOT Lane/Hour	95	43	133	103
		Average Number of Carpool Vehicles Using HOT Lane/Hour	572	383	791	408
		Average Number of Paying Vehicles on the HOT Lane/Hour	584	271	224	149
		Average HOT Lane Volume/Hour	1,251	697	1,147	660
		Average GP Volume/Hour	5,890	3,080	5,273	3,512
D	HOV 3+	Average Number of HOT/C Vehicles (free trips) on the HOT Lane/Hour	98	45	137	107
		Average Number of Carpool Vehicles Using HOT Lane/Hour	125	110	145	106
		Average Number of Paying Vehicles on the HOT Lane/Hour	748	384	551	321
		Average HOT Lane Volume/Hour	970	539	834	534
		Average GP Volume/Hour	6,171	3,238	5,586	3,638
		Limited Eligibility, 1 in 11 Rides Free				
E	HOV 2+	Average Number of HOT/C Vehicles (free trips) on the HOT Lane/Hour	26	12	36	28
		Average Number of Carpool Vehicles Using HOT Lane/Hour	572	383	791	408
		Average Number of Paying Vehicles on the HOT Lane/Hour	619	288	281	193
		Average HOT Lane Volume/Hour	1,216	683	1,108	629
		Average GP Volume/Hour	5,925	3,095	5,312	3,544
F	HOV 3+	Average Number of HOT/C Vehicles (free trips) on the HOT Lane/Hour	27	12	37	29
		Average Number of Carpool Vehicles Using HOT Lane/Hour	125	110	145	106
		Average Number of Paying Vehicles on the HOT Lane/Hour	772	397	611	361
		Average HOT Lane Volume/Hour	924	520	794	496
		Average GP Volume/Hour	6,217	3,258	5,626	3,677

Source: ECONorthwest, 2005.
Note: The vehicle counts include fractional amounts because the counts are averages across the various segments of the facility. In some cases, the individual counts are quite low and the fractional amount is displayed for precision purposes.

Table 14
Summary of Average Vehicle Volumes on HOT Lane during 2-Hour AM Peak Period in 2000 (cont.)

Scenario	Carpool Policy		I-680 South Bound	I-680 North Bound	I-580 West Bound	I-580 East Bound
		100% Eligibility, 1 in 11 Rides Free				
G	HOV 2+	Average Number of HOT/C Vehicles (free trips) on the HOT Lane/Hour	433	196	362	282
		Average Number of Carpool Vehicles Using HOT Lane/Hour	572	383	791	408
		Average Number of Paying Vehicles on the HOT Lane/Hour	405	187	118	46
		Average HOT Lane Volume/Hour	1,410	766	1,270	736
		Average GP Volume/Hour	5,731	3,011	5,150	3,436
H	HOV 3+	Average Number of HOT/C Vehicles (free trips) on the HOT Lane/Hour	444	206	375	292
		Average Number of Carpool Vehicles Using HOT Lane/Hour	125	110	145	106
		Average Number of Paying Vehicles on the HOT Lane/Hour	595	306	403	197
		Average HOT Lane Volume/Hour	1,164	622	924	595
		Average GP Volume/Hour	5,977	3,155	5,497	3,578
		100% Eligibility, 1 in 26 Rides Free				
I	HOV 2+	Average Number of HOT/C Vehicles (free trips) on the HOT Lane/Hour	183	83	153	119
		Average Number of Carpool Vehicles Using HOT Lane/Hour	572	383	791	408
		Average Number of Paying Vehicles on the HOT Lane/Hour	539	249	199	123
		Average HOT Lane Volume/Hour	1,294	715	1,143	651
		Average GP Volume/Hour	5,847	3,062	5,277	3,522
J	HOV 3+	Average Number of HOT/C Vehicles (free trips) on the HOT Lane/Hour	188	87	159	123
		Average Number of Carpool Vehicles Using HOT Lane/Hour	125	110	145	106
		Average Number of Paying Vehicles on the HOT Lane/Hour	713	366	534	297
		Average HOT Lane Volume/Hour	1,026	563	838	526
		Average GP Volume/Hour	6,115	3,215	5,582	3,647
		100% Eligibility, 1 in 51 Rides Free				
K	HOV 2+	Average Number of HOT/C Vehicles (free trips) on the HOT Lane/Hour	93	42	78	61
		Average Number of Carpool Vehicles Using HOT Lane/Hour	572	383	791	408
		Average Number of Paying Vehicles on the HOT Lane/Hour	585	271	518	169
		Average HOT Lane Volume/Hour	1,250	697	1,386	638
		Average GP Volume/Hour	5,891	3,081	5,034	3,535
L	HOV 3+	Average Number of HOT/C Vehicles (free trips) on the HOT Lane/Hour	102	48	91	67
		Average Number of Carpool Vehicles Using HOT Lane/Hour	125	110	145	106
		Average Number of Paying Vehicles on the HOT Lane/Hour	748	384	974	335
		Average HOT Lane Volume/Hour	976	542	1,210	507
		Average GP Volume/Hour	6,166	3,235	5,210	3,665

Table 14
Summary of Average Vehicle Volumes on HOT Lane during 2-Hour AM Peak Period in 2000 (cont.)

Scenario	Carpool Policy		I-680 South Bound	I-680 North Bound	I-580 West Bound	I-580 East Bound
		Tolling + No HOT/C Policy				
M	HOV 2+	Average Number of HOT/C Vehicles (free trips) on the HOT Lane/Hour	-	-	-	-
		Average Number of Carpool Vehicles Using HOT Lane/Hour	572	383	791	408
		Average Number of Paying Vehicles on the HOT Lane/Hour	631	294	301	211
		Average HOT Lane Volume/Hour	1,203	677	1,092	619
		Average GP Volume/Hour	5,938	3,100	5,328	3,553
N	HOV 3+	Average Number of HOT/C Vehicles (free trips) on the HOT Lane/Hour	-	-	-	-
		Average Number of Carpool Vehicles Using HOT Lane/Hour	125	110	145	106
		Average Number of Paying Vehicles on the HOT Lane/Hour	780	402	626	376
		Average HOT Lane Volume/Hour	905	512	771	482
		Average GP Volume/Hour	6,236	3,265	5,649	3,690

Table 15
Summary of Average Vehicle Volumes on HOT Lane during 2-Hour AM Peak Period in 2025

Scenario	Carpool Policy		I-680 South Bound	I-680 North Bound	I-580 West Bound	I-580 East Bound
		No Tolling/No HOT Credit (HOT/C) Policy				
A	HOV 2+	Average Number of HOT/C Vehicles (free trips) on the HOT Lane/Hour	-	-	-	-
		Average Number of Carpool Vehicles Using HOT Lane/Hour	617	615	1,127	726
		Average Number of Paying Vehicles on the HOT Lane/Hour	-	-	-	-
		Average HOT Lane Volume/Hour	617	615	1,127	726
		Average GP Volume/Hour	6,740	5,087	7,663	5,926
B	HOV 3+	Average Number of HOT/C Vehicles (free trips) on the HOT Lane/Hour	-	-	-	-
		Average Number of Carpool Vehicles Using HOT Lane/Hour	132	194	206	177
		Average Number of Paying Vehicles on the HOT Lane/Hour	-	-	-	-
		Average HOT Lane Volume/Hour	132	194	206	177
		Average GP Volume/Hour	7,226	5,507	8,583	6,475
		Limited Eligibility, 1 in 3 Rides Free				
C	HOV 2+	Average Number of HOT/C Vehicles (free trips) on the HOT Lane/Hour	101	68	192	172
		Average Number of Carpool Vehicles Using HOT Lane/Hour	617	615	1,127	726
		Average Number of Paying Vehicles on the HOT Lane/Hour	579	363	261	206
		Average HOT Lane Volume/Hour	1,297	1,045	1,580	1,104
		Average GP Volume/Hour	6,060	4,656	7,209	5,548
D	HOV 3+	Average Number of HOT/C Vehicles (free trips) on the HOT Lane/Hour	104	72	199	178
		Average Number of Carpool Vehicles Using HOT Lane/Hour	132	194	206	177
		Average Number of Paying Vehicles on the HOT Lane/Hour	755	541	713	501
		Average HOT Lane Volume/Hour	991	807	1,118	856
		Average GP Volume/Hour	6,367	4,895	7,672	5,796
		Limited Eligibility, 1 in 11 Rides Free				
E	HOV 2+	Average Number of HOT/C Vehicles (free trips) on the HOT Lane/Hour	28	18	52	47
		Average Number of Carpool Vehicles Using HOT Lane/Hour	617	615	1,127	726
		Average Number of Paying Vehicles on the HOT Lane/Hour	615	389	336	288
		Average HOT Lane Volume/Hour	1,260	1,022	1,515	1,061
		Average GP Volume/Hour	6,098	4,680	7,274	5,591
F	HOV 3+	Average Number of HOT/C Vehicles (free trips) on the HOT Lane/Hour	28	20	54	49
		Average Number of Carpool Vehicles Using HOT Lane/Hour	132	194	206	177
		Average Number of Paying Vehicles on the HOT Lane/Hour	779	561	791	578
		Average HOT Lane Volume/Hour	939	775	1,051	803
		Average GP Volume/Hour	6,418	4,926	7,738	5,849

Source: ECONorthwest, 2005.

Table 15
Summary of Average Vehicle Volumes on HOT Lane during 2-Hour AM Peak Period in 2025 (cont.)

Scenario	Carpool Policy		I-680 South Bound	I-680 North Bound	I-580 West Bound	I-580 East Bound
		100% Eligibility, 1 in 11 Rides Free				
G	HOV 2+	Average Number of HOT/C Vehicles (free trips) on the HOT Lane/Hour	459	308	524	469
		Average Number of Carpool Vehicles Using HOT Lane/Hour	617	615	1,127	726
		Average Number of Paying Vehicles on the HOT Lane/Hour	390	234	129	32
		Average HOT Lane Volume/Hour	1,467	1,157	1,780	1,227
		Average GP Volume/Hour	5,891	4,545	7,010	5,425
H	HOV 3+	Average Number of HOT/C Vehicles (free trips) on the HOT Lane/Hour	471	326	543	485
		Average Number of Carpool Vehicles Using HOT Lane/Hour	132	194	206	177
		Average Number of Paying Vehicles on the HOT Lane/Hour	598	420	506	308
		Average HOT Lane Volume/Hour	1,201	940	1,255	971
		Average GP Volume/Hour	6,156	4,761	7,535	5,681
		100% Eligibility, 1 in 26 Rides Free				
I	HOV 2+	Average Number of HOT/C Vehicles (free trips) on the HOT Lane/Hour	194	130	222	199
		Average Number of Carpool Vehicles Using HOT Lane/Hour	617	615	1,127	726
		Average Number of Paying Vehicles on the HOT Lane/Hour	531	329	251	187
		Average HOT Lane Volume/Hour	1,343	1,074	1,599	1,111
		Average GP Volume/Hour	6,015	4,627	7,190	5,541
J	HOV 3+	Average Number of HOT/C Vehicles (free trips) on the HOT Lane/Hour	199	138	230	205
		Average Number of Carpool Vehicles Using HOT Lane/Hour	132	194	206	177
		Average Number of Paying Vehicles on the HOT Lane/Hour	720	512	691	485
		Average HOT Lane Volume/Hour	1,051	844	1,127	867
		Average GP Volume/Hour	6,306	4,857	7,662	5,785
		100% Eligibility, 1 in 51 Rides Free				
K	HOV 2+	Average Number of HOT/C Vehicles (free trips) on the HOT Lane/Hour	99	66	113	101
		Average Number of Carpool Vehicles Using HOT Lane/Hour	617	615	1,127	726
		Average Number of Paying Vehicles on the HOT Lane/Hour	580	363	302	220
		Average HOT Lane Volume/Hour	1,296	1,044	1,541	1,047
		Average GP Volume/Hour	6,061	4,657	7,248	5,605
L	HOV 3+	Average Number of HOT/C Vehicles (free trips) on the HOT Lane/Hour	102	70	117	105
		Average Number of Carpool Vehicles Using HOT Lane/Hour	132	194	206	177
		Average Number of Paying Vehicles on the HOT Lane/Hour	756	541	754	567
		Average HOT Lane Volume/Hour	989	806	1,077	849
		Average GP Volume/Hour	6,368	4,896	7,712	5,803

Table 15
Summary of Average Vehicle Volumes on HOT Lane during 2-Hour AM Peak Period in 2025 (cont.)

Scenario	Carpool Policy		I-680 South Bound	I-680 North Bound	I-580 West Bound	I-580 East Bound
		Tolling + No HOT/C Policy				
M	HOV 2+	Average Number of HOT/C Vehicles (free trips) on the HOT Lane/Hour	-	-	-	-
		Average Number of Carpool Vehicles Using HOT Lane/Hour	617	615	1,127	726
		Average Number of Paying Vehicles on the HOT Lane/Hour	628	398	364	307
		Average HOT Lane Volume/Hour	1,245	1,013	1,491	1,033
		Average GP Volume/Hour	6,112	4,688	7,299	5,619
N	HOV 3+	Average Number of HOT/C Vehicles (free trips) on the HOT Lane/Hour	-	-	-	-
		Average Number of Carpool Vehicles Using HOT Lane/Hour	132	194	206	177
		Average Number of Paying Vehicles on the HOT Lane/Hour	788	568	815	636
		Average HOT Lane Volume/Hour	919	762	1,021	813
		Average GP Volume/Hour	6,438	4,939	7,769	5,839

Table 16
Summary of VMT and VHT during 2-Hour AM Peak Period in 2000

Scenario	Carpool Policy		I-680 South Bound	I-680 North Bound	I-580 West Bound	I-580 East Bound
		Hourly VMT	**108,687**	**57,190**	**83,467**	**49,066**
		No Tolling/No HOT Credit (HOT/C) Policy				
A	HOV 2+	Hourly VHT	5,619.1	973.1	1,581.3	765.7
B	HOV 3+	Hourly VHT	7,963.0	996.4	1,907.2	773.1
		Limited Eligibility, 1 in 3 Rides Free				
C	HOV 2+	Hourly VHT	3,629.6	955.4	1,496.7	762.2
D	HOV 3+	Hourly VHT	4,315.0	966.2	1,603.8	764.8
		Limited Eligibility, 1 in 11 Rides Free				
E	HOV 2+	Hourly VHT	3,699.3	956.0	1,506.6	762.5
F	HOV 3+	Hourly VHT	4,461.7	963.1	1,582.1	764.2
		100% Eligibility, 1 in 11 Rides Free				
G	HOV 2+	Hourly VHT	3,358.2	953.2	1,494.0	761.8
H	HOV 3+	Hourly VHT	3,782.1	957.6	1,530.8	762.7
		100% Eligibility, 1 in 26 Rides Free				
I	HOV 2+	Hourly VHT	3,549.5	954.8	1,497.1	762.3
J	HOV 3+	Hourly VHT	4,149.9	960.7	1,562.0	763.6
		100% Eligibility, 1 in 51 Rides Free				
K	HOV 2+	Hourly VHT	3,631.9	955.4	1,493.6	762.3
L	HOV 3+	Hourly VHT	4,316.2	962.0	1,555.3	764.0
		Tolling + No HOT/C Policy				
M	HOV 2+	Hourly VHT	3,727.0	956.1	1,505.2	762.5
N	HOV 3+	Hourly VHT	4,520.8	963.5	1,591.8	764.4

Source: ECONorthwest, 2005.

Table 17
Summary of VMT and VHT during 2-Hour AM Peak Period in 2025

Scenario	Carpool Policy		I-680 South Bound	I-680 North Bound	I-580 West Bound	I-580 East Bound
		Hourly VMT	**111,979**	**86,318**	**114,272**	**78,228**
		No Tolling/No HOT Credit (HOT/C) Policy				
A	HOV 2+	Hourly VHT	6,698.9	1,922.0	3,695.0	1,402.2
B	HOV 3+	Hourly VHT	9,866.2	2,280.1	5,911.3	1,560.4
		Limited Eligibility, 1 in 3 Rides Free				
C	HOV 2+	Hourly VHT	4,237.5	1,694.8	3,145.6	1,342.4
D	HOV 3+	Hourly VHT	5,180.6	1,857.8	3,881.1	1,399.9
		Limited Eligibility, 1 in 11 Rides Free				
E	HOV 2+	Hourly VHT	4,329.6	1,704.2	3,219.2	1,350.5
F	HOV 3+	Hourly VHT	5,382.5	1,814.7	3,757.2	1,386.1
		100% Eligibility, 1 in 11 Rides Free				
G	HOV 2+	Hourly VHT	3,880.5	1,661.7	3,111.6	1,334.9
H	HOV 3+	Hourly VHT	4,456.0	1,726.8	3,382.4	1,353.8
		100% Eligibility, 1 in 26 Rides Free				
I	HOV 2+	Hourly VHT	4,132.1	1,685.1	3,137.5	1,341.5
J	HOV 3+	Hourly VHT	4,956.2	1,775.2	3,604.3	1,373.0
		100% Eligibility, 1 in 51 Rides Free				
K	HOV 2+	Hourly VHT	4,240.7	1,695.1	3,170.8	1,347.1
L	HOV 3+	Hourly VHT	5,187.1	1,796.8	3,702.9	1,378.9
		Tolling + No HOT/C Policy				
M	HOV 2+	Hourly VHT	4,366.2	1,706.5	3,211.5	1,349.6
N	HOV 3+	Hourly VHT	5,464.0	1,822.2	3,821.7	1,384.7

Source: ECONorthwest, 2005.

Table 18
Summary of Alternative HOT Credit HOT/C) Policies on VHT, Revenue, and Capital and Operating Costs (I-680 and I-580, combined)

Scenario	Carpool Policy	Difference in Hourly Revenue from Base Case 2000 (AM Peak)	Difference in Hourly Revenue from Base Case 2025 (AM Peak)	Difference in Hourly Total VHT from Base Case 2000 (AM Peak)	Difference in Hourly Total VHT from Base Case 2025 (AM Peak)	Hourly HOT/C Users on HOT Lane 2000 (AM Peak)	Hourly HOT/C Users on HOT Lane 2025 (AM Peak)	Implied Travel Time Benefit of HOT/C Policy (Reduced VHT per HOT/C User) 2000 (AM Peak)	Implied Travel Time Benefit of HOT/C Policy (Reduced VHT per HOT/C User) 2025 (AM Peak)	Implied Lost Revenue Associated With HOT/C Policy (Lost Revenue per HOT/C User) 2000 (AM Peak)	Implied Lost Revenue Associated With HOT/C Policy (Lost Revenue per HOT/C User) 2025 (AM Peak)	Implied Capital and Operating Costs of HOT/C Policy (Amortized Cost per HOT/C User) 2000 (AM Peak)	Implied Capital and Operating Costs of HOT/C Policy (Amortized Cost per HOT/C User) 2025 (AM Peak)
Base Case: Conventional HOT Lane													
M	HOV 2+	$ -	$ -	-	-	-	-	NA	NA	NA	NA	NA	NA
N	HOV 3+	$ -	$ -	-	-	-	-	NA	NA	NA	NA	NA	NA
No Tolling/No HOT/C Policy (Conventional HOV Lane)													
A	HOV 2+	$ (5,058)	$ (13,600)	1,988	3,084	-	-	NA	NA	NA	NA	NA	NA
B	HOV 3+	$ (10,354)	$ (33,751)	3,799	7,125	-	-	NA	NA	NA	NA	NA	NA
Limited Eligibility, 1 in 3 Rides Free													
C	HOV 2+	$ (717)	$ (2,619)	(107)	(213)	374	533	0.29	0.40	$ 1.91	$ 4.91	$ 0.71	$ 0.50
D	HOV 3+	$ (1,191)	$ (4,908)	(191)	(173)	387	552	0.49	0.31	$ 3.07	$ 8.89	$ 0.69	$ 0.48
Limited Eligibility, 1 in 11 Rides Free													
E	HOV 2+	$ (202)	$ (752)	(26)	(30)	102	145	0.26	0.21	$ 1.98	$ 5.18	$ 2.61	$ 1.83
F	HOV 3+	$ (348)	$ (1,507)	(69)	(152)	106	151	0.66	1.01	$ 3.29	$ 10.00	$ 2.52	$ 1.77
100% Eligibility, 1 in 11 Rides Free													
G	HOV 2+	$ (2,723)	$ (8,130)	(384)	(645)	1,273	1,760	0.30	0.37	$ 2.14	$ 4.62	$ 0.21	$ 0.15
H	HOV 3+	$ (4,560)	$ (15,984)	(807)	(1,574)	1,317	1,825	0.61	0.86	$ 3.46	$ 8.76	$ 0.20	$ 0.15
100% Eligibility, 1 in 26 Rides Free													
I	HOV 2+	$ (1,289)	$ (4,078)	(187)	(338)	538	745	0.35	0.45	$ 2.39	$ 5.48	$ 0.49	$ 0.36
J	HOV 3+	$ (2,091)	$ (7,301)	(404)	(784)	557	772	0.73	1.02	$ 3.75	$ 9.46	$ 0.48	$ 0.34
100% Eligibility, 1 in 51 Rides Free													
K	HOV 2+	$ (678)	$ (2,173)	(108)	(180)	274	380	0.39	0.47	$ 2.47	$ 5.72	$ 0.97	$ 0.70
L	HOV 3+	$ (1,099)	$ (3,831)	(243)	(427)	307	394	0.79	1.09	$ 3.58	$ 9.74	$ 0.87	$ 0.68

Source: ECONorthwest, 2005.

Notes: 1. Dollar amounts are in 2004 dollars.

2. Incremental costs of HOT/C policy are derived from estimates provided by Acumen Building Enterprise, Inc. on 6/24/05. Capital costs were amortized over 20 years at an annual real discount rate of 3 percent

5.5 Conclusions

HOT Credit lanes policy is fundamentally a policy designed to remedy actual or perceived inequities in access to the superior service speeds of HOT lanes. The effect of HOT/C policy on toll revenues is provided as a way of measuring the impact on project financing of HOT/C lane policy. The impact on total vehicle miles traveled (VMT) is presented to capture the effect of the policy on total delay borne by users. Finally, the capital and operating costs associated with the facilities needed to implement HOT/C policy are provided as a means of measuring the additional project investment and day-to-day operating costs necessary to facilitate the HOT/C policy.

The analysis concludes the following:

1. There would be a significant opportunity cost to the public, in the form of forgone HOT lane revenues, associated with each HOT/C lane credit that is redeemed. This is because addition of non-paying vehicles on the HOT lane causes a decline in the level of service of the lane, with the result that paying users are less willing to pay for access to the HOT lane. HOT lane tolls per VMT decline, and there is a reduction in paying users. The opportunity cost of HOT lane credit redemption would be particularly high on the I-580 HOT lane under the 2+ carpool policy, because of the already high utilization of the lane by non-paying carpool users.
2. There are modest improvements in overall travel time savings (unweighted by the value of time) that would accompany adoption of HOT/C lane policy. On the margin, moving a vehicle off of the congested GP lane to the less congested HOT lane reduces total facility-wide VHT, everything else being equal. The net gains would be small per HOT/C user. In addition, the gains to GP uses and the losses to HOT lane users in terms of delay reduction must be considered in light of California's HOV lane policy to encourage carpool users, because degradation of HOT lane performance necessarily attends any changes in overall facility VHT.
3. The incremental costs of implementing HOT/C lane policy would be relatively small, in terms of the additional capital and operating costs that would attend implementation of such a policy. Once electronic billing systems are in place for conventional HOT lane pricing, the major incremental capital costs would be extension of toll antenna gantries across the GP lanes and the cost of administering the HOT/C policy. These are not significant costs in the context of the entire implementation of the HOT lanes.
4. The eligibility and HOT/C crediting policies adopted influence the operating characteristics of the overall facility. A low-income-based eligibility criterion severely limits the number of eligible users, by definition (particularly in these relatively affluent corridors, and permits a more generous crediting policy, everything else being equal. Adoption of a broad, all-user (100 Percent) eligibility policy necessitates limiting the accrual rate of HOT lane credits provided for each GP lane trip. Otherwise, the number of free users of the HOT lane would be very large, and the lane's performance degrades quickly to that of a GP lane, with the attendant loss in toll revenue and elimination of the incentive to carpool.
5. The relative generosity of the HOT/C credit policy, as well as the choice of carpool policy, has a significant impact on revenues and facility speed performance. For example, in the 100 Percent Eligibility scheme, an HOV 2+ carpool policy with a 1 in 11 trip HOT/C credit policy is essentially inoperable (due to overloading of free riders) on I-580 in both horizon years, and marginally operable on I-680. That is, HOT lane speeds approach GP lane speeds and little revenue can be generated. HOV 2+ carpool policies with 1 in 26 and 1 in 51 trips free perform better in terms of revenue and HOT lane speeds, but the crediting rate is so low as to be nearly meaningless.
6. There is also a high risk that users who have accumulated HOT/C credits may wish to utilize them during the same peak period on the same day. An accident on the GP lanes,

for example, would provide an incentive for users with accumulated credits to use them simultaneously. Absent other operational restrictions, therefore, the performance of the HOT lane may deteriorate very sharply as a result of high demand. It is possible that such synchronous behavior would eliminate any speed advantage for HOT lane users in the aggregate relative to the slowed GP lanes. In this sense, the value of the HOT/C credits may evaporate under precisely the operational conditions under which users may wish to redeem them, thereby essentially nullifying the value.

7. The amount of equity value that can be offered by a HOT/C lanes policy is limited substantially by the need to limit crediting rates in order to maintain satisfactory service on the HOT lane.

Therefore, the decision to adopt or to not adopt HOT/C Lane policy involves balancing the HOT lane revenue impacts against any perceived improvement in equity of access the policy provides. There are operational impacts as well, but with the exception of the prospects of synchronous credit redemption described above, these impacts are relatively minor.

6. REVENUE ESTIMATES

The primary purpose of this study and the associated tolling simulations is to evaluate alternative HOT/C policies, rather than to assess the financial feasibility of a new HOV or HOT lane. Nevertheless, it is interesting to compare the approximate total revenues that would be generated for each of the facilities under the various HOT/C and carpool policy alternatives. Consequently, the study team derived and applied expansion factors that permit rough estimation of annual, total revenues that would be collected under the various policy alternatives, including a pure HOT lane without HOT/C policy.

Precise measurement of the toll potential of a HOT lane facility requires modeling of tolls on a detailed, diurnal and weekly basis, since optimal toll levels vary with load and, hence, time of day and day of the week. This is a very resource intensive exercise that is more appropriate to a detailed project feasibility study than a policy study. However, having performed such detailed analyses on other facilities, including I-680, the study team is able to develop expansion factors to apply to the available, AM peak revenue estimates and expand these revenue estimates to an approximate annual level. When performed for the two model years, 2000 and 2025, it is then possible to interpolate and extrapolate revenues over a longer period of years.

6.1 Revenues for 20-Year Period

In this chapter the value of 20 years of estimated revenues is presented, from the assumed build year of 2009 to 2029. The present value calculation permits summarizing in a single number the total revenues likely to be generated for each alternative in current (2004) dollars. In the process of making these measurements, the sensitivity of total revenues to the various underlying modeling assumptions is also reported, along with the assumed discount rate.

In particular, the toll optimizations incorporated two assumptions. First, tolls produced by the TOM analysis were not fed back into the regional model. If such feedback had been implemented, equilibrium toll levels likely would have been somewhat lower, and total facility and HOT lane volumes would also be somewhat lower than in the seed run (in which only a small, nominal toll is assumed to be in place on the HOT lane). Second, it is likely that tolls in future year values will be elevated not only by general inflation, but also by increases in average household purchasing power, or “real income.” The effects on revenue of both including and excluding model-feedback and real income effects are tabulated in Table 19. In Table 20, both assumptions are relaxed to provide a conservative, lower estimate of total revenues. Additional sensitivity analysis regarding the effects of alternative discount rates is also presented.

Table 19
Summary of Present Value of Revenues (Millions of 2004 Dollars) Under Alternative Assumptions Regarding Real Income Growth and Model Feedback

		Approach A: Including Real Income Growth and Unadjusted for Elastic Demand/Carpool Formation		Approach B: Excluding Real Income Growth and Unadjusted for Elastic Demand/Carpool Formation		Approach C: Excluding Real Income Growth and Adjusted for Elastic Demand/Carpool Formation	
Scenario	Carpool Policy	I-680	I-580	I-680	I-580	I-680	I-580
		No Tolling/No HOT Credit (HOT/C) Policy					
A	HOV 2+	$0	$0	$0	$0	$0	$0
B	HOV 3+	$0	$0	$0	$0	$0	$0
		Limited Eligibility, 1 in 3 Rides Free					
C	HOV 2+	$386	$47	$230	$27	$138	$22
D	HOV 3+	$750	$267	$448	$154	$269	$123
		Limited Eligibility, 1 in 11 Rides Free					
E	HOV 2+	$418	$66	$250	$38	$150	$30
F	HOV 3+	$800	$309	$478	$178	$287	$142
		100% Eligibility, 1 in 11 Rides Free					
G	HOV 2+	$243	$25	$145	$15	$87	$12
H	HOV 3+	$525	$178	$314	$103	$188	$82
		100% Eligibility, 1 in 26 Rides Free					
I	HOV 2+	$345	$43	$206	$25	$123	$20
J	HOV 3+	$684	$261	$409	$150	$245	$120
		100% Eligibility, 1 in 51 Rides Free					
K	HOV 2+	$386	$57	$230	$33	$138	$26
L	HOV 3+	$748	$293	$447	$169	$268	$135
		Tolling + No HOT/C Policy					
M	HOV 2+	$431	$74	$257	$42	$154	$34
N	HOV 3+	$820	$329	$490	$190	$294	$152

Source: ECONorthwest, 2005.

Notes: 1. The revenue estimates presented here represent the present value of revenues from operation of the HOT/C lane between 2009 and 2028 (20 years), discounted back to 2004 at annual real discount rates of 4 percent.
2. Approach A includes assumed real income growth of 1.8 percent per year. Approach A does not correct for reduced usage of the facility and carpool formation that would be induced by a HOT/C lane policy.
3. Approach B does not include real income growth and does not correct for reduced usage of the facility and carpool formation that would be induced by a HOT/C lane policy.
4. Approach C does not include real income growth. In addition, a feedback adjustment factor of 0.6 was applied to the I-680 results and a factor of 0.8 was applied to the I-580 results to account for revenue reduction induced by reduced usage of the facility and carpool formation caused by a HOT/C lane policy.

Table 20
Summary of Present Value of Revenues (Millions of 2004 Dollars) Under Alternative Real Discount Rates

Scenario	Carpool Policy	3% Real Discount Rate I-680	3% Real Discount Rate I-580	4% Real Discount Rate I-680	4% Real Discount Rate I-580	5% Real Discount Rate I-680	5% Real Discount Rate I-580
No Tolling/No HOT Credit (HOT/C) Policy							
A	HOV 2+	$ -	$ -	$ -	$ -	$ -	$ -
B	HOV 3+	$ -	$ -	$ -	$ -	$ -	$ -
Limited Eligibility, 1 in 3 Rides Free							
C	HOV 2+	$ 159	$ 25	$ 138	$ 22	$ 120	$ 18
D	HOV 3+	$ 310	$ 145	$ 269	$ 123	$ 234	$ 105
Limited Eligibility, 1 in 11 Rides Free							
E	HOV 2+	$ 173	$ 36	$ 150	$ 30	$ 130	$ 26
F	HOV 3+	$ 331	$ 167	$ 287	$ 142	$ 250	$ 122
100% Eligibility, 1 in 11 Rides Free							
G	HOV 2+	$ 100	$ 14	$ 87	$ 12	$ 76	$ 10
H	HOV 3+	$ 217	$ 97	$ 188	$ 82	$ 164	$ 70
100% Eligibility, 1 in 26 Rides Free							
I	HOV 2+	$ 142	$ 23	$ 123	$ 20	$ 107	$ 17
J	HOV 3+	$ 283	$ 141	$ 245	$ 120	$ 214	$ 103
100% Eligibility, 1 in 51 Rides Free							
K	HOV 2+	$ 159	$ 31	$ 138	$ 26	$ 120	$ 22
L	HOV 3+	$ 309	$ 159	$ 268	$ 135	$ 234	$ 116
Tolling + No HOT/C Policy							
M	HOV 2+	$ 178	$ 40	$ 154	$ 34	$ 134	$ 29
N	HOV 3+	$ 339	$ 179	$ 294	$ 152	$ 256	$ 130

Source: ECONorthwest from 2000 and 2025 simulations of the regional travel demand model.

Notes:
1. The revenue estimates presented here represent the present value of revenues from operation of the HOT/C lane between 2009 and 2028 (20 years), discounted back to 2004 at annual real discount rates of three percent, four percent, and five percent.
2. For conservatism, these estimates have been adjusted to exclude real income growth.
3. The lack of feedback in the model implementations is addressed by applying a feedback adjustment factor. A factor of 0.6 was applied to the I-680 results and a factor of 0.8 was applied to the I-580 results to account for revenue reduction induced by reduced usage of the facility and carpool formation caused by a HOT/C lane policy "feed back" to the regional model.

6.2 Conclusions

1. Even under the most conservative assumptions, HOT lane tolling generates significant revenues over a 20-year period.

2. The results, however, reveal the great sensitivity of revenues to both HOT/C and carpool policy. HOT lane revenues are produced most prolifically when there is substantial HOT lane capacity to be sold, when there is a 3+ carpool policy in place and there are no "free riders" as a result of the HOT/C policy. The addition of HOT/C users and a generous 2+ free carpool policy have significant effects, therefore, on HOT lane revenues. In essence, both policies have the effect of reducing the capacity that is available to sell, the volume of paying users, and the total revenue generated.

3. Revenues are also significantly affected by the assumed sensitivity of total facility usage with tolls in place and whether or not increases in real household purchasing power are assumed. The revenue estimates depend upon the extent to which SOV and carpool volumes are sensitive to the tolls. If there is little total response of traffic to the presence of tolls, and real income growth is assumed, total revenues could easily be substantially more than derived under the more conservative assumptions that are provided.

4. Similarly, the amount of spending on facility development that could be supported by the projected revenues depends upon the assumed discount or financing rate. The higher the discount rate, the lower the purchasing power in today's dollars of a given stream of future revenues. Under the most diverse scenarios and assumptions as shown in Table 20, yielding highest and lowest revenues, the Limited Eligibility alternatives for I-680 yield a range of 20-year revenues from approximately $120 million to $331 million, and for I-580 a range from $18 million to $167 million. The 100 Percent Eligibility alternatives for I-680 yield a range from approximately $76 million to $309 million, and for I-580 a range from $10 million to $159 million. The low end of the revenue ranges is characterized by these assumptions: most generous crediting policies (100 Percent Eligibility), HOV2+ carpool policy, and highest real discount rate. The high end of the revenue ranges is characterized by the opposite assumptions: least generous crediting policies (Limited Eligibility), HOV3+ carpool policy, and lowest real discount rate.

7. COST ESTIMATES

This section discusses the preliminary incremental cost estimates for implementation of HOT/C lanes on both the I-680 and I-580 corridors.

With respect to I-580, no detailed cost estimates have been completed for the cost of converting conventional HOV lanes into HOT lanes. The cost for adding a conventional HOV lane on I-580 is estimated by Caltrans to be approximately $200 million. The estimate to convert one HOV lane in each direction on I-580 from HOV to HOT is $31.9 million. This cost estimate for converting HOV lanes to HOT lanes on I-580 is derived by applying the existing Caltrans I-680 HOT lanes cost estimates and adjusting for bidirectional lanes and for a shorter corridor length. However, it should be emphasized that this estimate is highly conceptual and subject to significant modification as planning for the addition of HOV lanes on I-580 proceeds. In any case, this estimate or conversion of HOV to HOT for I-580 has no bearing on the cost estimate presented in the rest of this chapter, because this is concerned only with the incremental cost of conversion of HOT lanes into HOT/C lanes.

7.1 Assumptions for Estimates

The cost estimate is for the incremental costs for implementation of HOT/C lanes under the Limited Eligibility HOT/C policy. For the purposes of this study, eligible HOT/C lanes customers are defined as those corridor users with incomes at or below 200 percent of the federal poverty index. In these relatively affluent corridors, the number of eligible users is quite low.

For both corridors, the following key assumptions were made: (1) Full integration with regional FasTrak electronic toll collection system, including account maintenance, transponder replacement, etc.; (2) Contract with California Highway Patrol for two additional patrol units daily, the cost of these patrols already being absorbed in the HOT lanes project and not an incremental cost for HOT/C lanes policy ; (3) Additional readers to cover all GP lanes; (4) Cost of each toll transaction is the same as current costs as reported by the Bay Area Toll Authority, which manages the FasTrak system; (5) Additional staffing for HOT/C lanes oversight and reporting; (6) Cost of additional software to implement HOT/C lanes concept to be shared equally by the two corridors; (7) Additional antennas and readers, including truss and foundation to support them, spanning the GP lanes, so that HOT/C-eligible vehicles with transponders can be read and their accounts credited.

HOT/C lanes implementation assumes the existence of the HOT lane. Implementation of a HOT/C policy requires that motorists in the GP lanes be given some amount of credit upon their use of these lanes during peak periods when tolls are being charged on the HOT lane. To monitor this usage, motorists would have to own transponders that would be read via the FasTrak system already in place in the San Francisco Bay Area for the toll bridges in the region. Under the HOT/C lanes scheme, reading the transponder of an eligible GP lane user would not result in debiting a prepaid account, but instead would provide a credit to the user's account. This would require that equipment be installed above each of the GP lanes, as well as other system modifications to keep track of the accounts. Accrued credits would be used towards future use of the HOT lane.

7.2 Capital Costs

The total estimated incremental capital cost to implement HOT/C lanes on I-680 is $1,177,500. For I-580, the estimated incremental capital cost is $1,603,125. These estimates are presented in Tables 21 and 22, with a summary table for both corridors in Table 23. Both corridor estimates include itemized capital components, plus a 25 percent contingency. The estimated incremental capital cost for implementing HOT/C lanes system on I-580 and I-680 HOT lanes combined is $2,780,625. The incremental O&M cost of implementing the HOT/C lane policy on both I-580 and I-680 HOT lanes combined is $345,140.

Table 21
I-580 HOT/C Lanes: Incremental Cost Estimate

Interstate 580	Quantity	Unit	Unit Cost	Capital Cost	Total Cost	Annual Operating Cost	Comments
Typical Antenna/Reader Station							
Antenna/Reader& 332 Cabinet	1	Ea	$ 30,000	$ 30,000			Monitors 4 general purpose lanes
Truss and Foundation	1	Ea	$ 150,000	$ 150,000			Additional foundations for readers spanning four general purpose lanes in each direction.
Typical Antenna/Reader Station Total Unit Cost					$ 180,000		Estimated unit cost for each segment.
					6		Number of segments planned for FAIR Lanes I-580. Three Eastbound and Three Westbound.
TOTAL Physical ETC Improvements for Corridor					**$ 1,080,000**		**Total Estimated Antenna/Reader Station Cost for 6 segments.**
System Software							
Software Development	1	Ea	$ 150,000	$ 150,000			Initial system setup -- FAIR Lanes software development (includes web enrollment, Customer Service Center (CSC) application processing and system modification). Represents 50% of total development cost (remaining 50% allocated to I-680).
					$ 150,000		**Total System Software Cost (remaining 50% allocated to I-680).**
Central Computer System	0	Ea	$0	$0			Costs included in BATA agreement. Assume existing BATA system implemented for I-680 will handle all backoffice and customer service center functions (See I-680 documentation)
Operations & Maintenance							
I-580 FAIR Lanes Transponders	1,500	Ea	$ 35	$ 52,500			Assume 10% of total peak-period users whi would not otherwise have transponders.
					$ 52,500		**Total Transponder Cost.**
FAIR Lanes Application		Annual	$ 2,000			$ 2,000	Assume annual printing cost of FAIR Lanes specific application (also see Software Development).
Maintenance	1	Annual	*Percentage*			$ 108,000	Assume yearly cost 10% of total antenna/reader system
Oversight & Reporting	1	Annual	$ 25,000			$ 25,000	Assume additional staffing of half-time person for additional FAIR lanes reporting and oversight, to be shared equally with I-680.
Administration	40,000	Annual (Transactions)	$ 0.12	$ -		$ 4,800	BATA annual costs of $0.12/transaction. Assumes some database or other modification to existing toll software added to I-580 facility
Marketing	1	Annual	$ 50,000			$ 50,000	I-580 HOT / FAIR Lanes Marketing campaign. Acumen Estimate.
Capital Cost Contingency 25%					**$ 320,625**		
						$ 189,800	
Total Capital Cost					$ 1,603,125		
Notes:							
1 - Caltrans approved Model SP1000CR: Power = 875 watts. Run Time = 2 Hours . Minimum Active Output Capacity = 700W/1000VA with 80 minimum inverter efficiency. $4000 for the unit and an additional $1000 for the external battery cabinet.							

Source: Acumen Building Enterprise, 2005

Table 22
I-680 HOT/C Lanes: Incremental Cost Estimate

Interstate 680	Quantity	Unit	Unit Cost	Capital Cost	Total Cost	Annual Operating Cost	Comments
Typical Antenna/Reader Station							
Antenna/Reader& 332 Cabinet	1	Ea	$ 5,000	$ 5,000			Monitors 3 general purpose lanes
Truss and Foundation	1	Ea	$ 120,000	$ 120,000			Additional foundation for readers spanning three general purpose lanes in each direction.
Typical Antenna/Reader Station Total Unit Cost					**$ 125,000**		Estimated unit cost for each segment.
					6		Number of segments planned for FAIR Lanes I-680. Three Northbound and Three Southbound.
TOTAL Physical Improvements for Corridor					**$ 750,000**		**Total Estimated Antenna/Reader Station Cost for 6 segments.**
System Software							
Software Development	1	Ea	$ 150,000	$ 150,000			Initial system setup -- FAIR Lanes software development (includes web enrollment, Customer Service Center (CSC) application processing and system modification). Represents 50% of total development cost (remaining 50% allocated to I-580).
					$ 150,000		**Software System Cost (remaining 50% allocated to I-580).**
Central Computer System	1	Ea		$ -			Costs included in BATA agreement. Assume existing BATA system for all backoffice and customer service center functions
Operations & Maintenance							
Transponders	1,200	Ea	$ 35	$ 42,000			Assumes 6% of total peak-period users are eligible for FAIR crediting.
					$ 42,000		**Total Transponder Cost.**
FAIR Lanes Application		Annual	$ 1,500			$ 1,500	Assumes annual printing cost of FAIR Lanes specific application (also see Software Development).
Maintenance	1	Annual	*Percentage*			$ 75,000	Assume yearly cost 10% of total antenna/reader system
Oversight & Reporting	1	Annual	$ 25,000			$ 25,000	Assume additional staffing of half-time person for additional FAIR Lanes oversight and reporting, to be shared equally with I-580.
Administration	32,000	Annual	0.12			$ 3,840	BATA annual costs at $0.12/transaction. Assumes some database or other modification to existing toll software added to I-680 facility.
Marketing	1	Annual	$ -			$ 50,000	I-680 FAIR Lanes Marketing campaign. Acumen Estimate.
Capital Cost Contingency 25%					**$ 235,500**		
						$ 155,340	
Total Capital Cost					**$ 1,177,500**		
Notes:							
1 - Caltrans approved Model SP1000CR: Power = 875 watts. Run Time = 2 Hours . Minimum Active Output Capacity = 700W/1000VA with 80 minimum inverter efficiency. $4000 for the unit and an additional $1000 for the external battery cabinet.							

Source: Acumen Building Enterprise, 2005

Table 23
Incremental Cost Estimate

	Estimated Costs			
	I - 580 FAIR		I - 680 FAIR	
	Capital	Annual	Capital	Annual
Total Antenna/Reader System Cost	$ 1,080,000		$ 750,000	
System Software	$ 150,000		$ 150,000	
Transponder Cost	$ 52,500		$ 42,000	
Operations and Maintenance		$ 189,800		$ 155,340
Capital Cost Contingency 25%	$ 320,625	$ -	$ 235,500	$ -
Total	**$ 1,603,125**	**$ 189,800**	**$ 1,177,500**	**$ 155,340**

Source: Acumen Building Enterprise, 2005

Hardware Cost

Implementation of HOT/C lanes on the corridors requires transponders to be read in the GP lanes in addition to the HOV lane. The HOV lane toll collection system consists of a reader and antenna. In order to provide the overlay of HOT lanes to account for the HOT/C lanes concept, three additional antennas on I-680 and four additional antennas on I-580 would be required (one for each GP lane) at each tolling location. The reader is a multi-channel device which has the capability to receive signals from the four antenna set at each monitoring segment. There are a total of six tolling segments on I-680, three southbound and three northbound. The antennas are installed on a cantilever truss. This allows the placement of an antenna directly above each lane. This antenna/reader system at each segment of the corridor has provisions for complete communications, battery back-up system, truss foundation, trenched conduit for electrical wiring, pull boxes, power conductors, and a metering cabinet. The antenna/reader system incremental cost for I-680 is $750,000 for I-680 and $1,070,000 for I-580. The difference between the two corridors is a result of the need to span four GP lanes in each direction for I-580, while I-680 requires spanning only three GP lanes in each direction.

Software Cost

HOT/C lanes require the development of a crediting system to process transponder transactions in the GP lanes. This requires software development or enhancement to the current Electronic Toll Collection System (FasTrak) software. The change to the current software to implement a crediting system is the reverse of the debiting function of FasTrak. HOT/C lanes require that a credit be given to the FasTrak account as a result of a transaction. This credit would accrue based on a predefined rate, assumed for the purposes of this study to be a percentage of the HOT lane toll rate at the time of GP lane usage. When the user has accumulated sufficient credits, the transponder would allow the motorist free passage in the HOV lane. A precise algorithm is needed to allow credits to accrue and the integration with the FasTrak software. The development cost would be non-recurring. This software cost is assumed to be shared equally by both the I-580 and I-680 projects for a total of $300,000, split into $150,000 each for I-680 and I-580 respectively.

7.3 Operations and Maintenance

Operations and maintenance (O&M) cost estimates include both the administrative components and physical components. For the purposes of this study, only the low-income HOT/C lanes options are estimated, because that is considered to be the far more likely option to be adopted by policy-makers in this region. If all GP lane users were eligible rather than just low-income users, the number of transponders, accounts and transactions would be increased by an order of magnitude; the cost for that unlikely scenario is not estimated in this study.

The total annual O&M cost estimate is $155,340 for I-680 and $189,800 for I-580. The difference is accounted for by the one additional GP lane in each direction on I-580 and the higher percentage of eligible low-income users on I-580.

HOT/C Lanes Applications

The HOT/C lanes application process would require slight modifications to the current administrative processes. There would be two different costs associated with adding questions of self certification to the application process: the cost for printing new application forms and the cost for revising current processes, e.g., web-based enrollment, mail or in-person customer service center (CSC) application processing procedures, and modification to the service center's review process. Rather than revising the existing application forms, a new/separate application form specially designed for low-income persons applying to use HOT/C lanes would be developed. There would be an estimated annual cost of $3,500 to print application forms for both corridors combined.

Most new FasTrak enrollments are completed at the CSC's website. Since verification documents (e.g., tax return or pay stubs) would have to be submitted as part of the application process, HOT/C-eligible applicants would not be able to apply online. Instead, they would be instructed to obtain a special application form, attach verification documents, and mail in the application and verification documents to the CSC for processing. The cost to make the above revisions to the website would be incorporated into the software cost, included above.

The CSC application processing procedures, which is handled by CSC staff, would require several extra minutes to verify and process the HOT/C lane application; the verification would likely be done on a random spot-check basis rather than verification of each application. According to the operators of the FasTrak system, this would be done at negligible extra cost and thus is not included as a line-item in this estimate.

Transponders

It is estimated that there would be a total of 1,200 new transponder accounts to implement HOT/C lanes on I-680 and 1,500 on I-580; the difference is accounted for by the slightly higher percentage of low-income eligible users on the I-580 corridor. With a current estimated cost of $35/transponder, a total transponder cost of $42,000 was derived for I-680 and $52,500 for I-580. It should be noted that transponder acquisition costs by other toll facilities in other parts of the U.S. have shown that this cost has been decreasing recently, as is often the case as new technology matures and finds a mass market. Thus, the $35/transponder estimate is conservative, and the cost is likely to be considerably less when a new system is eventually implemented.

Equipment Maintenance

This estimate includes an annual maintenance cost of ten percent of the total antenna/reader system cost.

Other Administrative Costs

This includes oversight, reporting and marketing. The HOT/C lanes scheme will require a modest incremental amount of additional staffing and marketing, though it would largely be subsumed into the HOT lanes budgets for those functions, because the ongoing HOT lanes program would include all of these functions. However, this estimate assumes one half-time person whose annual full-time salary and benefits are $100,000; therefore, the incremental cost of the HOT/C lanes program would be $50,000, split equally between the I-680 and I-580 projects. The same formula is used for the estimated annual marketing cost (extrapolated from the HOT lanes marketing cost estimated in the previous I-680 study); this cost is estimated at $100,000 annually, split equally between I-680 and I-580. The HOT/C lanes marketing cost would include special outreach efforts to low-income corridor communities to make them aware of the HOT/C lanes benefit and to assist them in making applications.

8. OPERATIONAL ANALYSIS

The purpose of this analysis is to provide a discussion of operational characteristics of several alternatives for the HOV/HOT lanes under consideration for I-580 and I-680. This analysis provides input into how the lane functions operationally as a HOT lane, HOT/C lane or simply a conventional HOV lane. With the information and resources currently available, a full operational analysis is not feasible, so a qualitative evaluation and limited quantitative evaluation of two of the 14 scenarios is provided, first for I-580, then for I-680. The two scenarios selected for study of each facility represent the extremes, the least and most usage (most extreme traffic conditions) of the proposed lane configurations under consideration. The rationale for selecting the two extreme scenarios is to establish a range of impacts for analytical purposes. In the event that a HOT or HOT/C lane project moves forward, significant additional operational analysis will need to be prepared. It should be noted, however, that the 100 Percent Eligibility HOT/C lane was not included in this analysis, because it is deemed highly unlikely to be implemented. The two scenarios selected for analysis are:

- Scenario M of the alternatives is a conventional HOT lane with a 2-person carpool policy and no HOT/C policy. Year 2000 conditions were evaluated for this concept. This is the scenario with the least impact from a HOT/C policy.
- Scenario C is a Limited Eligibility HOT/C lane with a 2-person policy and a 1 in 3 trips crediting rate. This concept has the highest volume of traffic that would use the HOT/C lane. Under this scenario, drivers can pay to use the lane, ride free if they are a 2+ carpool, or if they qualify as low-income they can be credited for one free trip of the lane for every three trips of the GP lanes. Year 2025 conditions were evaluated for this concept.

8.1 Demand Forecast Results

Demand volumes were initially provided for each of the two alternatives by the MTC travel demand model and then processed using the TOM economic model. Originally, the volumes were forecast as AM peak two-hour volumes, but for this operational analysis, the one-hour peak volumes were needed to better evaluate level of service, so they are estimated from the two-hour volumes. Since this analysis is a mostly qualitative analysis, the two-hour volumes were divided in half. It should be noted that assuming equal volumes for the two hours of the peak period may be more appropriate for the Year 2025 volumes, than for the Year 2000 volumes, since increasing demand in 2025 may imply a fully saturated two-hour peak at that time. The model results do not include feedback effects, such as potential diversion to other routes; however, the relative lack of alternative routes indicates that this feedback effect is likely to be minor.

It also should be noted that the volumes for both the 2000 and 2025 years appear to be lower than volumes for other recent studies using other models. Having different demand volumes from different models is certainly expected, but it is noteworthy here, because some of the volumes produced by the MTC/VTA model for the eastern edge of the study area are well below generally accepted operational capacities.

Tables 24 and 25 provide summaries from the key travel demand forecasting/TOM modeling results used in the operational analysis for the two alternatives selected for analysis. The results are for both HOT lanes and GP lanes at selected locations in the I-580 and I-680 corridors summarizing vehicle volumes during the AM one-hour period for the peak direction only, Volume/Capacity (V/C) ratios, and peak hour travel speeds. Table 24 provides results for Scenario M representing a year 2000 HOT lane with 2+ carpool policy and zero HOT/C credit Scenario M). Table 25 provides results for Scenario C representing a year 2025 HOT lane with 2-person policy and 1 in 3 trips HOT/C credit.

Table 24
Forecast Results at Selected Locations for Scenario M in Year 2000

Location	Volumes			V/C		Travel Speed	
	HOT	GP	Total	HOT	GP	HOT	GP
I-580							
West of Vasco Rd	746	4,872	5,618	0.43	0.68	64.81	61.47
East of Isabel Ave	746	6,288	7,034	0.43	0.87	64.80	51.38
West of Airway Blvd	990	7,432	8,422	0.57	1.03	63.95	37.73
West of Tassajara/ Santa Rita	753	5,733	6,486	0.43	0.80	64.79	56.41
I-680							
South of Rte 84	940	6,910	7,850	0.54	1.28	64.22	17.95
North of SR 237	874	7,008	7,882	0.50	1.30	59.46	37.71

Source: Dowling Associates, Inc. 2005.

Table 25
Forecast Results at Selected Locations for Scenario C in Year 2025

Location	Volumes			V/C		Travel Speed	
	HOT/C	GP	Total	HOT/C	GP	HOT/C	GP
I-580							
West of Vasco Rd	1,590	7,251	8,841	0.91	1.01	50.62	40.05
East of Isabel Ave	1,590	7,564	9,154	0.91	1.05	50.62	36.05
West of Airway Blvd	1,928	9,281	11,209	1.10	1.29	34.18	17.38
West of Tassajara/ Santa Rita	1,088	7,363	8,451	0.62	1.02	63.17	38.62
I-680							
South of Rte 84	1,420	7,184	8,604	0.81	1.33	56.81	15.07
North of SR 237	1,188	6,764	7,952	0.68	1.25	56.74	40.60

Source: Dowling Associates, Inc. 2005.

8.2 I-580 Analysis

The HOT/FAIR lane access nearest the future Isabel Avenue interchange was selected for the I-580 analysis location. This is chosen primarily because the Isabel Avenue interchange is located at the crossroads of two major state routes. This location produces significant traffic transfers with the potential to develop more operational issues on both the mainline from/to the HOT/C lane than the rest of the I-580 corridor.

Mainline Operation

There are two primary considerations for operational characteristics of traffic where the accesses are for a HOT or HOT/C lane. One consideration is the general capacity for the mainline to accept the total number of vehicles entering, or to accommodate vehicles leaving. The other consideration is the number of vehicles desiring to access the HOT or HOT/C lane itself.

In general, the first consideration is less significant to address in this context, because the HOT/C lane is not significantly increasing traffic to the mainline, and the operational impacts to the mainline would have been addressed in the I-580 HOV or other freeway studies. The only notable aspect of this issue related to the HOT or HOT/C lane concept is that, with limited access points, some number of vehicles will choose to use an interchange ramp different from one they would otherwise use under an unlimited, continuous access policy. Under Scenario C, the highest volume of traffic entering I-580 to use the lane would be about 340 vehicles (at Isabel). Many of these vehicles would use this interchange anyway, even without the HOT or HOT/C lane. If it is assumed that approximately half of these would have otherwise used one of the adjacent interchanges (Airway or North Livermore) in order to enter I-580 (25 percent each interchange), this could mean that up to 170 vehicles would be diverting to the Isabel interchange for the purpose of using the HOT or HOT/C lane.

However, since vehicles entering upstream of Isabel (at North Livermore) would still be able to enter the lane after traveling the distance from North Livermore to the Isabel access point, it is reasonable to assume that some of them will do so. Assuming half of the vehicles that would otherwise use North Livermore would indeed use it, this would mean a maximum diversion of vehicles to Isabel (and consequentially an increase in the on-ramp volume at Isabel) of about 130 vehicles (170 potentially divert; all 85 Airway Boulevard vehicles would divert; half of the 85 North Livermore vehicles would divert; 85+43=128, say 130). This maximum number would represent about one additional vehicle every half minute, which would not appear to be significant.

The second consideration involves atypical traffic operations. Under ordinary circumstances, with no special lane, vehicles entering a freeway merge into the right-hand lane and they either stay in that lane or merge when they believe it is safe to do so in order to use the other lanes as they see fit. With a continuous access HOV lane, HOV vehicles also merge into the right-hand lane, then as their comfort level allows, merge to the left until they reach the HOV lane. For a limited-access lane, however, vehicles must merge within a certain limited distance in order to reach the lane before passing the access point. This increases the urgency of merging to some degree and can potentially cause more congestion than a standard HOV lane whenever a merging vehicle performs a more dramatic merging maneuver.

In order to evaluate this situation, it is important to understand what typically happens at a merge point. Some distance upstream of an on-ramp, some of the vehicles will merge to the left to avoid potential conflicts from the entering traffic. The *Highway Capacity Manual* (HCM) ramp junction methodology includes, as part of the steps to determine level of service, a calculation of the total volume present in Lanes 1 and 2 (the right-hand lanes). Under a typical on-ramp situation for a four-lane (one direction) freeway segment, the ratio of volume in Lanes 1 and 2 to the volume in Lanes 3 and 4 might be on the order of 40:60.

For illustrative purposes, a four-lane mainline segment is carrying a total flow of 5,000 vehicles per hour (vph). At the point where an on-ramp joins the mainline, say the estimate of volume in Lanes 1 and 2 turns out to be about 2,000 vph. This means that there is a volume of 3,000 vph in Lanes 3 and 4. So Lanes 3 and 4 are each carrying a volume of 1,500 vph and Lanes 1 and 2 are each carrying a volume of 1,000 vph in this example.

The part of this analysis that is relevant is the volume of the lane into which HOT or HOT/C lane traffic is merging. As it merges into Lane 1 (and subsequently into Lane 2), it is merging into a volume

about 2/3 that of Lanes 3 and 4. This is an important observation because as volumes increase overall, the volume in Lanes 3 and 4 begins to approach capacity.

Under Scenario M at the I-580/Isabel location, the freeway volume forecast upstream of the on-ramp is 6,234, and the HOT/C component of on-ramp traffic is 276. Using a 40:60 ratio of Lanes 1-2 to 3-4 would result in lane volumes of about 1,250 vehicles per hour per lane (vphpl) and 1,870 vphpl. Adding the 276 vph to the Lanes 1-2 volumes would leave the volume well below a typical capacity of 2,000-2,200 per lane. Adding that volume to Lanes 3-4, however, would put the volume in each of those lanes at or near capacity, at about 2,150 vph. Some slowing and congestion would therefore be expected at that location. It would also be expected, as the 276 vehicles merge into Lanes 3 and 4 (causing the volume in those lanes to approach capacity), that the 1-2:3-4 split would change. Some vehicles in lanes 3-4 would observe the better operating conditions in Lanes 1-2 and would merge to the right.

Under Scenario C at I-580/Isabel, the forecast freeway volume upstream of the on-ramp is 7,056, and the HOT/C component of on-ramp traffic is 339. Under these conditions, with a higher freeway volume, a more balanced split of traffic between Lanes 1/2 and 3/4 would be expected, so a 45/55 split is assumed. This would result in 1,940 vphpl in Lanes 3 and 4 and 1,590 vphpl in Lanes 1 and 2. Adding the 339 HOT/C vehicles into Lanes 3 and 4 would result in lane volumes of 2,280 vphpl. This value is about at capacity or slightly over, and with the other non-HOT/C traffic entering the freeway flow would likely begin to break down with this volume.

HOT or HOT/C Lane Operation

In addition to the operation of the entire facility, the operation of the HOT or HOT/C lane itself must also be considered. The capacity of the HOT lane could vary widely, depending on the physical characteristics of its construction. Ordinary HOV lanes tend to operate significantly less than the usual capacity of a freeway lane because the much slower (even stopped) vehicles in the adjacent lane cause drivers to drive much more cautiously than under mixed-flow conditions. But a separated or buffered HOT or HOT/C lane could have a higher capacity if sufficient shoulder widths are included and if visual distractions of the GP lanes are somehow minimized. In any case, this evaluation assumes a HOT lane capacity of 1,800 vph.

Under Scenario M, the highest forecast volume along I-580 is 990, so such a lane would operate well under capacity. The highest forecast volume along I-580 for a special lane under Scenario C would be 1,928, which is higher than the capacity stated above. This condition could result in several potential situations:

- The excess demand could simply queue up if conditions in the mixed flow lanes were worse.
- The excess demand could choose to use the GP lanes instead. This would likely be a case where someone with an option to use a credit or gain a credit would choose to gain a credit (travel in the GP lanes) because there would be a lower benefit-to-cost ratio of using the special lane.
- The excess demand could cause a fluctuation of conditions in the lane. This condition could happen if vehicles entered the lane and filled the capacity, saw better conditions in the GP lanes and exited the special lane, thereby causing worse congestion in the GP lanes, so reentered the special lane at the next opportunity, and so on.

8.3 I-680 Analysis

Operational conditions along I-680 would differ from I-580. For purposes of this study, fewer access points are assumed along I-680, and fewer vehicles would be joining the HOT or HOT/C lane. If anything, vehicles would be exiting. Under peak congested conditions, vehicles entering or exiting the HOT lane experience similar operational conditions; however, during the shoulder of the peak,

exiting is somewhat simpler operationally than entering. This is because exiting vehicles are already traveling at prevailing speeds and are looking ahead for gaps in slower traffic to exit, while vehicles entering a freeway find it more difficult as they must accelerate to reach the prevailing speeds, and drivers are looking backwards for available gaps. Therefore, this analysis focuses only on the capacity of the HOT/C lane itself. Similar to the I-580 special lane, the highest Scenario M forecast volume along I-680 is well below capacity at 940 vph. The highest I-680 Scenario C forecast volume for the special lane is higher, at 1,420. This volume is still well within capacity. Therefore the HOT/C lane would operate at an acceptable LOS D or better.

8.4 Conclusions

The Scenario C (maximum usage) demand volumes appear to be close to or slightly over capacity for I-580, but not on I-680, while the Scenario M (minimum usage) demand volumes seem to be well below capacity. It is reasonable to assume that ramp metering will be in place by the time any such lane is constructed, so it is likely the volumes could be controlled enough to keep actual volumes within capacity.

One key element to successful operations would be the physical construction of the lane, such as the (type of buffer separating the HOT lane from the adjacent lanes and width of the shoulders.) Another element would be the locations of the access points relative to the access interchanges. The location of entry points should be as far as is feasible from the interchange that nominally serves the lane, but upstream enough from the next interchange's on-ramp.

By focusing the operational analysis on the two alternatives representing the extremes of the proposed HOT/C lane configurations (least usage and most usage), the analysis has bracketed the range of potential impacts. The analysis shows that the concepts studied in the report would function adequately for all the scenarios, using the proposed access locations, HOV policies and future transportation network and land use assumptions. Some of the scenarios, specifically 2025 with HOV-2 free and generous HOT/C crediting policy, may strain the lane and produce service levels worse that LOS D, but this performance would still be better than the freeway mainline.

While there are no specific methods for evaluating LOS on HOT lanes, there are concepts in the HCM used in freeway operations that could be applied to single lane HOT lanes. Freeway LOS is related to vehicle density and this could be simply applied to HOT lanes using the V/C ratio measure. If the V/C ratio for a given period exceeds 0.93, the facility would transition from operating at LOS D to LOS E. Some monitoring system would be implemented (electronic vehicle counting) when the HOT lane is operational to measure usage and adjust the tolls to maintain the desired operating LOS.

9. FINDINGS AND CONCLUSIONS

This chapter describes the key findings of the HOT/C lanes alternatives and presents conclusions based on the study's analysis. This chapter also presents the challenges associated with implementation of the HOT/C lanes proposal.

9.1 HOT/C Lanes Feasibility Considerations

1. There is a cost to the public, in the form of forgone HOT lane revenues, by adopting a HOT/C lane policy, whether Limited Eligibility or 100 Percent Eligibility. Because addition of non-paying vehicles using their HOT/C credits results in a decline in the level of service and a smaller capacity to "sell" to paying vehicles, the number of paying vehicles and the amount they are willing to pay are reduced. In addition to the loss of revenue due to less capacity to sell, there is a direct loss of revenue associated with HOT/C lane users who would have otherwise paid to use the HOT lane.

2. The opportunity costs are particularly high on the I-580 HOT lane under the 2+ carpool policy because of the high utilization of the lane by non-paying users. The 3+ carpool policy performs much better in terms of revenue than does the 2+ policy, under all HOT and HOT/C policy scenarios.

3. The Limited Eligibility criterion for HOT/C credits does not have a major impact on the facility operations when crediting levels are not generous (i.e., 1-in-11 trips for free), because so few users meet the criterion, and it takes numerous trips to build up enough credits for a "free" trip. However, the relatively generous crediting policy (1-in-3 free trips) does make a significant dent in revenue, especially in the context of the 20-year revenue stream. The 100 Percent Eligibility criterion, on the other hand, has the potential of having a major impact on the operation of the facility and on revenues in both the short-and long-term. Therefore, the crediting rates must be very low (1-in-26 or lower) for the 100 Percent Eligibility scheme, so the credits are almost negligible and may not be worth the administrative or public relations difficulties.

4. The direct, incremental operating costs of implementing the HOT/C lanes policy on an already existing HOT lane are relatively small. As noted above, the major operating cost is the forgone revenue.

5. HOT/C lanes alternatives provide modestly lower speeds on the HOT lane as compared to the pure HOT Lane alternatives.

6. The HOT/C lanes alternatives are characterized by fewer toll-paying customers on the HOT lanes.

7. There are modest improvements in overall net time savings for the entire freeway that accompany the HOT/C lane policy. On the margin, moving a vehicle off of the congested GP lane to the less congested HOT lane reduces facility-wide vehicle hours traveled. However, the net gain per HOT/C lane user is small, and the losses to HOVs and paying HOT lane users must be weighed in light of California's policy to favor HOVs.

8. There is a high risk that users who have accumulated HOT/C credits may wish to utilize them during the same peak period on the same day. For example, an incident causing serious traffic congestion on the GP lanes would provide an incentive for users with accumulated HOT/C lanes credits to use them simultaneously. Absent other operational restrictions, therefore, the performance of the HOT lane may deteriorate very sharply as a result of high demand. In this

sense, the value of the HOT/C credits may evaporate under precisely the operational conditions under which users may wish to redeem them.

9.2 Implementation Challenges

The implementation of HOT/C lanes on I-580 and I-680, as an additional feature of a HOT lanes program, faces several major challenges. A HOT/C lanes system on both freeways would need to satisfactorily address the following issues.

1. **Agency and Stakeholder Consensus**. Numerous local and state decision-makers would need to reach a consensus that a HOT/C lanes concept, which has never been tried elsewhere, is an experiment worth implementing. The local officials would include Alameda, Contra Costa, Santa Clara and perhaps San Joaquin counties, plus regional and state agencies such as MTC and Caltrans. If undertaken, a HOT/C lanes scheme would be an attempt to address a perceived equity problem with HOT lanes that would otherwise be a serious obstacle to their gaining acceptability with the public.
2. **Equity concerns**. Equity concerns, as they pertain to low-income users, may be important to elected officials, transit advocates, and other opinion leaders, but as discussed in Chapter 4, they do not appear to be so important to the general public. Decision-makers would need to determine that this equity concern is significant enough that it warrants introducing a complication into the toll structure, operation, and administration into the HOT lanes. They may also wish to consider other ways to address this perceived equity issue, such as a simple toll discount for certified, low-income users whenever they use the HOT lanes. Alternatively, they may wish to address equity by using revenues generated by the HOT lanes for improving express bus service or reducing fares on such service.
3. **Corridor travel impacts**. Because HOT/C lanes customers, when they use their accumulated credits, will to some degree take space that would otherwise be available for regular carpools or toll-payers, they will have an impact on corridor performance. This has an impact on both the GP and HOT lanes, both positive and negative (positive on GP lanes, negative on HOT lanes). Decision-makers will need to assess whether the benefits for some outweigh the adverse impacts for others.
4. **Use of revenues**. Because a meaningful HOT/C lanes credit means forgone revenue, there will be less revenue available to fund other purposes, such as paying for bonds to build the HOT lanes, other corridor capital improvements, or improved transit service on the corridor. This represents a challenging policy decision, because it requires balancing different sets of values, such as equity, which are difficult to quantify.

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Appendix A
Value Pricing State-of-the-Art Review

This section presents an overview of the state-of-the-art of value pricing, describing the concept of value pricing, followed by examples of implemented pricing projects, public perceptions on value pricing, and opportunities and challenges related to the this study.

The Concept of Value Pricing

"Value pricing" (also referred to as "congestion pricing" or "variable pricing") is a method that seeks to address urban highway congestion. The concept applies simple supply-and-demand economics to transportation operations, using price to signal the value of meeting traffic demand, especially during peak traffic time periods. Many aspects of our economy apply some version of the principle that access to a facility or service should reflect the demand placed on it at different times. Telephone service, for example, charges different rates for their prices by time of day or season - in some cases, seeking to shift demand from peak periods to off-peak, in order to improve efficient utilization of the facility and maximize revenue. Pricing in those contexts seeks to allocate scarce capital assets to meet demand over time. In that sense, value pricing on roads is simply a way to improve the management of limited road capacity by applying simple supply-and-demand principles. Other familiar examples are to be found in airline, hotel, electricity and movie ticket prices.

The full cost of an individual trip on a congested road includes not just a traveler's own time and vehicle operating costs, but also the costs that each traveler imposes on all other travelers by adding to the overall level of congestion. A congestion price is a user charge based on a user's perceived cost when entering the traffic stream and the actual congestion cost created by the traveler's entry onto the system. Road pricing can result in more efficient use of limited road capacity by encouraging those who value their trips at less than their full cost to shift to off-peak periods, mass transit, carpooling, and/or less congested routes.

Determining optimal congestion prices is difficult. Estimates can be based on the traffic engineering research that deals with the relationship between travel delays and traffic volume. Analysts have derived estimates of current "optimal" congestion prices on the order of 15 to 30 cents per vehicle mile of travel on congested highways and expressways; off-peak prices are in the range of six cents per vehicle mile. However, actual optimal prices could vary widely for each local context, based on degree of congestion, local incomes, availability of alternate routes or modes, or other factors.

Examples of Pricing Projects

Implementation of value pricing may take a number of forms, but all share the objective of reducing traffic congestion. Types of value pricing applications include:

- Single-facility pricing involving a highway, bridge, or tunnel
- Multiple-facility or area pricing by creating a "cordon" around an urban core area or even a regional application

Examples of where single-facility pricing have been implemented include the State Route (SR) 91 Express Lanes in Orange County, California (opened in late 1995), the Interstate 15 (I-15) Toll Lanes in San Diego, California (opened in 1997), the New York and New Jersey metropolitan bridges and tunnels (instituted in 2001), and the I-394 MnPass Hot Lanes Project in Minneapolis, Minnesota (opened in May 2005).

Multiple-facility or area pricing has been implemented or is planned in a number of locations overseas, but not yet in the United States. Singapore, which was the first to implement value pricing

in 1975, has a central city electronic toll collection system, as does downtown London, which implemented its system in 2003. The Netherlands, Norway, Sweden and New Zealand are also seriously undertaking pricing projects.

To provide a comparison for this study, which examines the application of single-facility pricing on I-580 and I-680 in the San Francisco Bay Area, examples of value pricing projects implemented in the United States are described below, with information regarding:

- Pricing Concept
- Design Issues (e.g., lane separation and access)
- Operational Issues
- Technologies
- Enforcement
- Management/Accounting/Revenue Allocation

SR 91 Express Lanes in Orange County, California

This 10-mile privately funded and managed toll facility opened in December 1995. It consists of the four inside lanes of a freeway corridor, two in each direction, which are separated by a pyloned buffer from adjacent lanes. The remainder of the freeway is four GP lanes in each direction. There are no entrances or exits to the Express Lanes other than at the end points. In January 2003 the private company, California Private Transportation Company (CPTC), sold the facility to a public agency, the Orange County Transportation Authority (OCTA), for $207.5 million, but the private firm has continued as the facility operator.

The SR 91 freeway is extremely congested during peak commute hours, with heavy traffic in the morning in the westbound direction (from Riverside County to Orange County) and in the eastbound direction in the afternoon and evening. The SR 91 Express Lanes charge users between $1.00 and $6.25 per trip ($0.625 per mile) depending on the time of day, to reflect the level of congestion delay avoided as compared to the adjacent free lanes. Since the Express Lanes were opened, tolls have been raised a total of six times. Once they are adjusted, tolls are frozen for at least six months. High occupancy vehicles (HOVs) with three or more occupants are allowed to travel for free, except when traveling eastbound, Monday through Friday between the hours of 4:00PM and 6:00PM. During that peak time, 3+ HOVs receive a 50 percent discount on the posted toll. This policy also applies to motorcycles. Large trucks with more than two axles are not allowed on the Express Lanes.

This project is the first fully electronic and automated toll road in the United States. All vehicles using the Express Lanes must have a transponder (similar to the San Francisco Bay Area's FasTrak), including 3+ HOVs which use a separately designated entrance/access lane. The Express Lanes are physically separated from the parallel unpriced freeway by a 4-foot wide painted buffer area, consisting of two sets of double yellow lines and permanently placed 24-inch plastic traffic pylons located at 20-foot intervals. The "wall" of pylons makes it difficult for violators to traverse the painted buffer. As a part of an agreement with the State of California, the California Highway Patrol (CHP) provides enforcement services on the Express Lanes, including enforcement of traffic laws pertaining to speed, carpool, and toll evasion violations. In addition to officers stationed at the entrances to the Express Lanes, photo surveillance is also used for enforcement, whereby license plate photos are taken of all vehicles entering the Express Lanes to identify toll violators.

New state legislation sponsored by OCTA and recently signed into law, stipulates that toll revenue can only be spent on general toll road operating expenses, ongoing maintenance to the lanes, and improvements in the 91 Freeway corridor. When OCTA acquired ownership of the Express Lanes, the non-compete clause with the California Department of Transportation (Caltrans) was removed, allowing improvements to be made on the unpriced freeway lanes. Caltrans completed construction

of an auxiliary lane on the westbound SR 91 freeway between the Riverside County line and the Eastern Toll Road (SR 241). OCTA is currently examining additional improvements to the corridor to address increased traffic congestion.

I-15 HOT Lanes in San Diego, California

In December 1996 an existing 8-mile, barrier-separated, underutilized 2-lane reversible HOV facility was converted to high-occupancy toll (HOT) lanes. At the beginning of the experiment, a limited number of drivers were offered the opportunity to purchase "Express Pass" permits for a monthly fee of $50, which was then increased over several months to $70 due to high demand. The permits allowed a single-occupant vehicle to use the HOV lanes during peak hours. Due to the popularity of the program, the demand for permits far exceeded the number sold.

Electronic tolling was implemented in late 1997, and in 1998 the program began using "dynamic pricing." Dynamic pricing means that, instead of a predetermined toll rate, the rate fluctuates according to the amount of traffic actually on the road during that particular time of day. Tolls may change as often as every six minutes. An electronic message board displays the fare to drivers at the entrance. The average peak-period price is approximately $4.00 ($0.50 per mile), though on rare occasions (usually when a serious traffic incident causes severe congestion) the price can be as high as $8.00, the maximum allowed. HOVs and motorcycles continue to ride for free. Commercial trucks are not allowed on the HOT lanes.

By the nature of the reversible operation, the HOT lanes are separated from adjacent lanes by permanent concrete barriers, with ingress and egress only available on either end. The HOT lanes are open to southbound traffic in the morning between 5:00AM and 11:00AM, closed for up to an hour between 11:00AM and 12:00PM to reverse directions, and reopened to northbound traffic between 12:00PM and 7:00PM. The facility is closed at night on weekdays and open 24 hours during the weekend. CHP officers, working voluntary overtime shifts, provide enforcement services on the HOT lanes. The officers stationed at the entrance of the toll zone visually inspect carpool vehicles and FasTrak customers. An electronic monitor tells officers if a solo motorist is a qualified FasTrak customer who has paid a toll.

The approximately $2.4 million in annual toll revenues collected from the HOT lanes are used to fund operations, enforcement, planning studies, and bus service improvements in the corridor. Currently, the San Diego Association of Governments (SANDAG) is undertaking a $750 million I-15 Managed Lanes Project, including a 12-mile extension of the HOT lanes on I-15, for a total of 20 miles at build-out; four-lane, two-way reversible operations; and movable barriers. The project, which is being developed in three phases, began construction in November 2003 and is planned for completion by 2010-2015.

I-394 MnPASS Project in Minneapolis, Minnesota

Minnesota's Department of Transportation opened its first toll lane in May 2005 on I-394. The toll operation converts the existing I-394 carpool-bus lanes into pay lanes, allowing solo drivers to pay a fee to use the express lanes between the western suburbs and downtown Minneapolis. Specifically, the MnPASS toll lanes extend for approximately eleven miles on I-394 from I-94 to just west of I-494. The lane separation between HOT and general purpose lanes is striping for approximately eight miles and a reversible physical barrier for the remaining three miles. Initial reports indicate that it is performing well and has been accepted by the public, but it is too early in the implementation phase to make any evaluation.

The project was developed and completed through a public/private partnership involving the State of Minnesota and service vendor Wilbur Smith Associates. The private firm will fund 20 percent of the project's estimated $10 million price tag.[17]

[17] http://www.mnpass.org/394/index.html

MnPASS Toll Lanes are special-use "express" lanes that provide additional capacity. Drivers can pay a toll to use the MnPASS lane to achieve more reliable travel times, or they can choose to use the adjacent non-toll lanes.

The lanes will remain free for carpools, bus riders and motorcycles. MnPASS drivers can lease a small electronic transponder that attaches to their windshield behind the rear view mirror. The toll is automatically deducted from their pre-paid Mn/PASS account, by toll recording equipment located on the road. Fees may vary in amount by time of day and the level of traffic congestion. The prices are dynamically set as often as every three minutes to keep traffic flowing in the MnPASS lanes. Thus far, full trip rates from I-494 to I-94 have ranged from $0.25 to $4.50 ($0.06 to $0.56 per mile).

In terms of enforcement, two kinds of violators will be ticketed $130 per offense: drivers using the lanes without opening a toll account and those crossing the double white line that will divide the toll lanes from GP lanes. The Minnesota Department of Transportation has budgeted $200,000 for enforcement by officers during the first year of the toll lanes.

Although the goal of the project is to maximize capacity in the I-394 corridor, MnPASS provides drivers with a choice, helps control congestion on metro area roadways and provides a new source of revenue for transportation.

Mn/DOT is working on a program that will engage private partners to share in the cost of developing toll lanes on other congested routes. Once these new lanes open, MnPASS transponders will work for them as well.

Quickride – Katy Freeway in Houston, Texas

Similar to the San Diego program, in January 1998 the Metropolitan Transit Authority and Texas Department of Transportation (TXDOT) opened a 13-mile reversible, barrier-separated HOV lane on the Katy Freeway (Interstate 10) to two-person carpools for a fee during the most heavily congested AM and PM peak hours. Ingress and egress are at either end of the HOV lane (no intermediate access).

Carpools of three or more ride for free, and single-occupant vehicles are not eligible to use the lane. Previously, carpools of two or more were permitted to ride for free, but the policy was changed to three-plus to reduce traffic on the HOV lane due to overcrowding by two-person carpools. The Quickride lane uses windshield transponders to charge $2.00 per trip.

The reversible HOV/HOT lane is separated from GP freeway lanes by three-foot high concrete barriers. In support of police enforcement, drivers are asked to report HOV lane violations such as insufficient occupancy, speeding or improper passing by calling the HERO Hotline at 713-921-HERO (4376). Drivers are requested to provide information such as vehicle license plate number, vehicle description, date, location and time the violation occurred.

Based on the experience of the Katy Freeway, Houston extended the Quickride application to another HOV lane facility on US 290, also allowing two-person carpools to buy into the lane. It has also begun reconstructing the Katy Freeway and considering expanding the toll lanes. Toll revenues are used for toll lane operating and maintenance costs.

Toll Bridges in Lee County, Florida

In November 1997 the Florida Department of Transportation installed electronic toll collection on two existing toll bridges (Cape Coral and Midpoint Bridges) and the next year introduced a 50 percent discount for use during non-peak traffic hours. Under the pricing plan, a 50 percent toll discount is provided for trips made during the half-hour period before the morning peak (7:00AM – 9:00AM) and in the two-hour period following the morning period. In the evening, the discount period is two hours before the evening peak (4:00PM – 6:30PM) and one-half hour after the peak. The pricing strategy

has caused drivers to shift trips to the shoulders of the peak, leading to improved service for bridge users. Lee County is now considering a priced "queue-jumping" lane.

Toll Bridges and Turnpike in New York and New Jersey

In March 2001 the Port Authority of New York and New Jersey instituted a mild form of variable pricing for all bridges and tunnels between the two states. The price variations were available only to users of electronic toll collection equipment. The policy had a dual purpose: 1) encourage use of electronic transponders to ease collection and improve traffic flow; 2) encourage a shift in travel from the peak period to the shoulder or off-peak. The toll structure is: $4 off-peak, $5 peak, $6 for cash payers. Preliminary indications showed a modest shift (about 4-7 percent) shift from peak to off-peak trips, but a significant increase (from 46 percent of transactions before variable pricing to 79 percent after) in the use of electronic toll technology and in carpool transactions (21 percent). The New Jersey Turnpike instituted a similar program with slight discounts for those using electronic transponders during both peak and off-peak periods. The electronic toll rate is generally 25 percent lower than the cash rate during off-peak periods, and generally 15 percent lower than the cash rate during peak periods (between 7:00AM - 9:00AM and 4:30PM - 6:30PM on weekdays, and all day on weekends). Analysis is underway to assess the long-range impact of these programs.

Other applications of value pricing in the United States, albeit with very modest variations in price, include the toll roads in Orange County (the 73, 241, 261 and 133 Toll Roads). These toll roads are owned and maintained by Caltrans, but managed by two legally separate government agencies. The San Joaquin Hill Transportation Corridor Agency manages the 73 Toll Road and the Foothill/Eastern Transportation Corridor Agency oversees the 241, 261 and 133 Toll Roads. Tolls on these facilities vary between peak and off-peak, as well as between FasTrak and cash payment. For example, the toll structure on the 73 Toll Road (Catalina View Mainline) is: $2.50 FasTrak off-peak, $3.00 FasTrak peak (Monday-Friday: northbound 7:00AM – 9:00AM, southbound 4:00PM – 7:00PM), $3.00 cash off-peak, and $3.50 cash peak.

In addition to the implemented projects there have been a number of pre-implementation studies done around the nation. They include major studies in the San Francisco Bay Area, Santa Cruz, Los Angeles, New York City, Colorado and Oregon.

Public Perception

As value pricing on roads is still a relatively new concept in the United States, public perceptions on this issue are mixed but shifting towards greater acceptance as the public actually experiences the facilities. Public opinion of toll facilities in Southern California has been generally positive, and the number of transponder accounts continues to increase for these facilities, including the SR 91 Express Lanes, I-15 HOT Lanes, and toll roads in Orange County. In Lee County, Florida, more than 70 percent of respondents in a 1999 user survey favored the variable pricing program on the toll bridges. Early efforts in the 1990's to implement value pricing in Minnesota were met with local opposition. However, the emergence of political champions from a Value Pricing Task Force in Minnesota enabled the passage of 2003 legislation supporting conversion of HOV lanes into HOT lanes, specifically on above-mentioned I-394 in Minneapolis.

Equity

Studies conducted for SR 91 Express Lanes show that frequency of use was somewhat correlated with income, but there were users at all incomes. While many high-income travelers use the Express Lanes frequently, a substantial number also report they infrequently or never use the toll lanes. In addition, some low-income travelers use the toll lanes frequently and more use the lanes with lower frequency. Results of public outreach and survey research for the I-15 HOT Lanes indicate that congestion pricing is considered effective and fair by all income groups. Equity was not perceived to be a problematic issue for either users or non-users; and there were no significant differences among the survey responses based on income or ethnicity.

In the mid-Atlantic region, there has been opposition to value pricing on the basis of equity, until recently. According to a Washington Post article on December 29, 2003, "AAA dubbed such toll lanes 'Lexus lanes,' favoring more affluent motorists" and "Former Maryland governor Parris N. Glendening (D) canceled the region's only study of such lanes in 2001 after calling them economically unfair."[18] However, the article also states that, "…with money tight and traffic growing worse, HOT lanes are now widely viewed as one of the most feasible, affordable ways to better manage, if not ease, traffic congestion in the short term while generating money for long-term relief." AAA has reconsidered its position on value pricing and the Maryland and Virginia state governments are now promoting HOT lanes on various highways in the region, though none is yet in operation. The Governor of Maryland, Robert Ehrlich, is favorably disposed to value pricing and is promoting further studies and application of the concept.

Benefits of value pricing to users include improved reliability by maintaining free flow on the toll roads and travel time savings. HOT lanes in California and Texas also gained support among motorists who did not use them regularly, because they were seen as diverting more vehicles from the general purpose lanes.[19]

Based on study findings, travelers were selective in deciding when and under what conditions to use the SR 91 Express Lanes. About half of the customers used the lanes once a week or less. According to focus groups conducted for the toll roads in Orange County, drivers like knowing that the toll roads are available, even though they do not use them every day.

According to surveys conducted for toll facilities in Southern California, female commuters are significantly more likely than male commuters to be frequent users. Safety and reliability are cited as important factors to this trend. The 1999 surveys in Lee County, Florida also show women are more likely to take advantage of the variable pricing program on the toll bridges.

Opportunities and Challenges

Based on the state-of-the-art review of value pricing, a summary of opportunities and challenges pertinent to this *study* are presented below.

Opportunities

Many recent forces and policy goals have caused transportation authorities to consider value pricing. These include:

- Rapid growth in urban travel demand
- High cost of constructing additional urban road capacity, often in highly constrained rights-of-way

[18] A 2nd Look At Snubbed HOT Lanes: Traffic-Fighting Idea Gains Favor in Region, by Katherine Shaver, Washington Post staff writer, December 29, 2003.
[19] Ibid.

- Environmental or neighborhood objections to roadway construction and expansion
- Availability of new electronic tolling technologies that reduce implementation costs and streamline collection
- Desire for cost-effective strategies to reduce air pollution and energy consumption
- Need for better management of existing or planned facilities, especially those including HOV components
- Need for new transportation revenue sources to build and operate new facilities or services

Furthermore, in February 2003 the Reason Foundation issued a report advocating a nationwide network of HOT lanes.[20] The Reason Foundation proposal postulates a HOT lane network in eight major metropolitan areas, including conversion of existing HOV lanes and new facilities to HOT/Bus Rapid Transit (BRT) lanes. The proposed benefits of a HOT lane network include: "congestion insurance" for all drivers in the metropolitan area, allowing them the option to bypass congestion when needed; greater productivity than underutilized HOV lanes; and a major new funding source for urban transportation infrastructure.[21]

The "Congestion Pricing Pilot Program" was established initially by the Intermodal Surface Transportation Efficiency Act (ISTEA) in 1991 and continued in the Value Pricing Program in the subsequent federal authorization legislation in 1998, known as TEA-21. Provisions on road pricing in the versions of the latest federal transportation reauthorization legislation propose to: reinstate the limit to the number of projects to not more than 25 projects, require that any project that involves collection of tolls should include a program to "permit low-income drivers to pay a reduced toll amount," and require that $3 million of funds made available for the program be available "only for congestion pricing pilot projects that do not involve highway tolls." The bill is pending Senate-House conference committee review, agreement, and the President's signature or veto.

Challenges

The challenges and issues related to value pricing on roads apply equally to any HOT lanes proposal, including the HOT/C lanes variants. The HOT/C lanes concept adds further issues.

1. *Need for a champion and local support.* In those cases where a HOT lane has been implemented, there was a strong political or institutional "champion" for the project. It is also important to build support for pricing at the local level through corridor-level public outreach and market research.
2. *Effective facility design is needed for efficient operations.* Key design considerations include entry and exit points on the toll facility and separation between GP and toll lanes. If a separately designated lane for HOVs is provided at the entrance to the toll facility, the design must take into account any merging operations. A design that allows frequent or continuous access and egress would greatly increase the complexity of managing and enforcing a HOT lane. To date, the only HOT lanes in operation have no intermediate access. Lane separations may range from a painted buffer area to concrete barriers, depending on facility operations (reversible vs. non-reversible lanes) and safety concerns.
3. *Adequate enforcement is necessary to deter traffic violations on the toll facility.* Patrol officers are typically stationed at toll facility entrances to check for vehicle occupancy and electronic toll payment. Technological advancements could also assist in enforcement efforts. OCTA recently

[20] *HOT Networks: A New Plan for Congestion Relief and Better Transit*, by Robert W. Poole, Jr. and C. Kenneth Orski, February 2003.
[21] *HOT Networks: A New Plan for Congestion Relief and Better Transit*, testimony of Robert W. Poole, Jr. presented to the Joint Economic Committee, Dirksen Senate Office Building, May 6, 2003.

installed new electronic toll collection and photo surveillance equipment on the SR 91 Express Lanes, which have a system accuracy of over 98 percent.

4. *Pricing should be set to keep traffic free flowing.* Whether dynamic pricing is used, as with the I-15 HOT Lanes, or toll rates are set by a predetermined toll schedule, as with the SR 91 Express Lanes, pricing levels should be evaluated on a frequent, regular basis to determine that adequate levels of service are maintained on the toll facility.

5. *Revenues can vary widely.* Depending on the degree of congestion, time savings, reliability, and form of pricing, revenue potential can be significantly lower or higher. Actual traffic volumes on a toll facility may be lower than projected, leading to lower revenues than expected and greater difficulty in repaying bonds in the anticipated timeframe, as in the case of the toll roads in Orange County. This represents a challenge in attracting private sector investors.

Appendix B
Travel Demand Modeling

Forecasting Methodology

The methodology for the forecasting of HOT/C lanes followed a two-phase approach that included both travel demand modeling and economic analysis. The travel demand modeling provided input to the economic analysis. The economic analysis resulted in toll structures that were tested using the demand model.

The forecasting methodology used the MTC/VTA model as modified for use in the previous *I-680 Value Pricing Feasibility Study* (2003). The model has network and land use assumptions for 2000 and 2025. The networks are consistent with the MTC 2001 Regional Transportation Plan (the 2005 RTP was not yet approved at the time that study was completed) and the socio-demographic data (land use) is based on ABAG *Projections 2000*. Enhancements were made to the mode choice process in order to test the HOT/C lanes concept with various crediting levels for low-income users.

Travel Demand Model Alternatives

Alternatives for testing with the travel demand model and subsequent Toll Optimization Model (TOM) were defined and are described in Chapter 4. The scenarios are based on the Alternatives Definition. The focus in comparing alternatives was on how economic features impact travel demand and behavior. The primary objective was to develop alternatives that are distinct enough to yield meaningful results for testing the HOT/C lanes concept. This entails creating a range of results by providing a high or generous credit on one end of the spectrum and a very low credit at the other end. The baseline run assumes limited access in terms of location, but all vehicle classes (including single-occupant vehicles and HOVs) may use the lane with no tolls; this is a theoretical configuration that will actually not be implemented in the field.

This configuration allows for full demand to be measured and provides input to the subsequent economic modeling (hereafter called the "seed run"). The 2000 and 2025 alternatives include:

2000

1. Calibration case (i.e., existing facility without HOT/HOV lane; for initial calibration purposes)
2. Do Nothing, (i.e., conventional HOV lane)
3. With HOT lane and conventional HOT tolling (in essence, represents HOT/C lane with zero credit; the initial run of this alternative would impose zero tolls to seed TOM© model)
4. With HOT lane and HOT/C policy with maximum credit (maximum credit would be that which still maintains a Level of Service of D on the HOT lane)
5. With HOT lane and HOT/C policy with a substantially lower level of credit

2025

6. Do Nothing with HOV lanes on I-580 and I-680
7. With HOT lane and conventional HOT tolling (in essence, represents HOT/C lane with zero credit; the initial run of this alternative would impose zero tolls to seed TOM© model)
8. With HOT lane and HOT/C policy with maximum credit. Maximum credit would be that which still maintains an acceptable level of service of HOT lane
9. With HOT lane and HOT/C policy with a substantially lower level of credit

The alternatives include the uniform features and assumptions described in Chapter 4 as appropriate for each alternative. These include corridor segments, lane separations, ingress, egress, toll collection, enforcement, credits and HOV definitions.

In addition to the alternatives described above, a number of iterations are required for each active alternative between the demand model and the TOM model in order to derive optimal tolling parameters that are consistent with the regional model.

HOT/C Lanes Access Locations

I-680 Corridor

Limited access locations were previously identified for the I-680 corridor during the recently completed *I-680 Value Pricing Feasibility Study*. The access locations included entry and exit points at each end of the corridor and one intermediate access location for each direction of travel. Table B-1 describes the access locations on I-680. These access locations were determined to be suitable for testing of the HOT/C lanes concept on I-680.

Table B-1
HOT Lanes Access Locations on I-680

Location	Access		Access Type
SR 84 (Vallecitos Road)	west-bound on	east-bound off	Start - wb / End - eb
Auto Mall Parkway/ Durham	west-bound on west-bound off	east-bound off east-bound on	Intermediate Access/ Egress
Landess Ave/Montague Exp	west-bound off	east-bound on	Start - eb / End - wb

Source: Dowling Associates, Inc. 2005

I-580 Corridor

An evaluation was conducted to determine suitable access locations for the I-580 portion of the HOT/C lanes. The evaluation relied on existing ramp counts supplemented by a select link analysis to determine key travel paths. The I-580 corridor has numerous interchanges with an additional one planned at Isabel Avenue in the future. Due to the characteristics of the corridor, the analysis identified a number of possible access locations. Caltrans staff provided input on the final selection of access locations. The access locations on I-580 are identified in Table B-2.

Table B-2
HOT Lanes Access Locations on I-580

Location	Access		Access Type
Greenville Road	west-bound on	east-bound off	Start - westbound/End - eastbound
Vasco Road	west-bound on	east-bound off	Intermediate Access/ Egress
Isabel Avenue	west-bound on west-bound off	east-bound off east-bound on	Intermediate Access/ Egress
Tassajara/Santa Rita Road	west-bound on west-bound off	east-bound on	Intermediate Access/ Egress
Hopyard/ Dougherty Road		east-bound on	Start – eastbound
I-580/I-680	west-bound off		End – westbound

Source: Dowling Associates, Inc. 2005

Forecasting Results

Base Model Validation

The existing year 2000 MTC model was compared to counts in the study area and validated to provide a closer match. The validation was conducted for the AM peak 2-hour period. Table B-3 shows a summary comparison of counts and model results at selected locations on both the I-580 and I-680 corridors. During the AM peak 2-hour period, the results show the model is predicting relatively close to actual traffic counts in the overall corridors while there is generally greater variation on individual links.

Table B-3
Model Validation Results

Location	Peak Direction -- West/South-Bound			
	Count	**Volume**	**Difference**	**% Difference**
I-580 West of Vasco Road	12,155	11,683	-472	-3.89%
I-580 West of Airway Blvd	16,331	15,839	-492	-3.02%
I-680 North of Rte 84	9,160	11,302	2,142	23.38%
I-680 North of Mission Blvd	11,873	12,625	752	6.33%
I-680 North of Scott Creek Road	14,532	13,174	-1,358	-9.34%
Total	64,052	64,623	571	0.89%
Location	**Non-Peak Direction -- East/North-Bound**			
	Count	**Volume**	**Difference**	**% Difference**
I-580 West of Vasco Road	9,995	7,912	-2,083	-20.84%
I-580 West of Airway Blvd	11,165	10,585	-580	-5.20%
I-680 North of Rte 84	6,146	6,599	453	7.37%
I-680 North of Mission Blvd	6,996	7,600	604	0.00%
I-680 North of Scott Creek Road	10,516	11,086	570	5.42%
Total	44,819	43,782	-1,037	-2.31%

Source: Dowling Associates, Inc. 2005

Model Forecasting Results

The MTC/VTA demand model was implemented for 2000 and 2025 conditions for all non-toll alternatives. The non-toll alternatives included no-build, HOV, and full demand (this configuration operates as a separate one-lane facility that functions as a GP lane with limited access and was modeled purely for seeding of the HOT/C lane). These alternatives were primarily run for comparison and as seed runs for the economic modeling. The tolled alternatives, including HOV/Toll and HOT/C alternatives were analyzed using the economic modeling. The following tables compare key results, with Table B-4 showing corridor travel times and Table B-5 showing forecast segment volumes, for the non-tolled alternatives for 2000 and 2025 for the AM 2-hour period. The tables include separate summary results for both the HOV and the GP lanes.

Table B-4
Forecasting Results – AM Peak 2-Hour Travel Time (in minutes)

Year	Corridor Travel Times	I-580			
		WB		EB	
		Restricted Use Lane	General Purpose Lanes	Restricted Use Lane	General Purpose Lanes
2000	No-Build	0.0	13.6	0.0	10.6
	HOV	10.3	12.0	10.2	10.3
	Full Demand	12.7	11.8	10.5	10.2
2025	No-Build	0.0	27.0	0.0	12.3
	HOV	14.0	18.7	10.2	11.3
	Full Demand	37.0	18.1	12.8	11.1

Year	Corridor Travel Times	I-680			
		SB		NB	
		Restricted Use Lane	General Purpose Lanes	Restricted Use Lane	General Purpose Lanes
2000	No-Build	49.1	36.1	0.0	23.9
	HOV	30.2	39.7	20.0	23.5
	Full Demand	43.9	38.3	20.1	23.2
2025	No-Build	33.8	34.3	0.0	31.2
	HOV	35.6	46.7	21.3	29.4
	Full Demand	59.0	44.0	23.8	28.2

Source: Dowling Associates, Inc. 2005

Table B-5
Forecasting Results – AM Peak 2-Hour Segment Volumes

Location	Alternative	Direction					
		WB/SB			EB/NB		
	2000	HOT/HOV	GP	Total	HOT/HOV	GP	Total
I-580 West of Vasco Rd	Validation	-	11,683	11,683	-	7,912	7,912
	No-Build	-	11,108	11,108	-	7,359	7,359
	HOV	1,616	9,710	11,326	717	6,778	7,495
	Full Demand	2,892	8,376	11,268	1,593	6,027	7,620
I-580 West of Airway Blvd.	Validation	-	15,839	15,839	-	10,585	10,585
	No-Build	-	15,326	15,326	-	10,224	10,224
	HOV	2,556	13,772	16,328	962	9,252	10,214
	Full Demand	3,422	13,490	16,912	1,782	8,529	10,311
I-680 North of Rte 84	Validation	-	11,302	11,302	-	6,599	6,599
	No-Build	-	12,031	12,031	-	6,670	6,670
	HOV	-	12,089	12,089	-	6,580	6,580
	Full Demand	-	12,132	12,132	-	6,645	6,645
I-680 North of Fremont	Validation	-	12,625	12,625	-	7,600	7,600
	No-Build	-	12,031	12,031	-	6,670	6,670
	HOV	2,413	12,449	14,862	806	6,766	7,572
	Full Demand	3,634	12,048	15,682	1,803	6,863	8,666
I-680 North of Milpitas	Validation	-	13,174	13,174	-	11,086	11,086
	No-Build	3,741	11,771	15,512	-	10,203	10,203
	HOV	2,140	12,588	14,728	1,275	9,364	10,639
	Full Demand	3,867	11,881	15,748	1,859	8,858	10,717
Location	**2025**	**HOT/HOV**	**GP**	**Total**	**HOT/HOV**	**GP**	**Total**
I-580 West of Vasco	No-Build	-	17,094	17,094	-	11,053	11,053
	HOV	2,645	14,821	17,466	1,161	9,870	11,031
	Full Demand	4,339	13,755	18,094	2,463	9,446	11,909
I-580 West of Airway	No-Build	-	20,408	20,408	-	15,992	15,992
	HOV	4,024	18,101	22,125	1,905	14,406	16,311
	Full Demand	5,109	18,029	23,138	3,173	13,514	16,687
I-680 North of Rte 84	No-Build	-	12,943	12,943	-	10,228	10,228
	HOV	-	13,178	13,178	-	10,433	10,433
	Full Demand	-	13,328	13,328	-	10,548	10,548
I-680 North of Fremont	No-Build	3,920	13,547	17,467	-	12,404	12,404
	HOV	3,314	13,589	16,903	1,766	10,744	12,510
	Full Demand	4,295	12,988	17,283	3,001	8,681	11,682
I-680 North of Milpitas	No-Build	3,394	12,532	15,926	-	13,061	13,061
	HOV	2,597	12,724	15,321	1,869	11,858	13,727
	Full Demand	3,947	12,231	16,178	2,776	11,404	14,180

Source: Dowling Associates, Inc. 2005

Appendix C

Focus Groups Moderator's Guide

I. Introduction (15 minutes *for section*/15 minutes *time elapsed*)
   A. Introduce self/EMC
   B. Disclosures
      1. One way mirror
      2 Video/Audiotape
      3. Food
   C. Focus group rules
      1. I want you all to speak but ask that you don't all speak at the same time
      2. Avoid side conversations/One discussion
      3. You are encouraged to disagree but respect the viewpoint of others
      4. The only wrong answers are those that are not offered
   D. Introduction of participants
      1. Name
      2. Where they live and how long
      3. Marital Status
      4. Children
      5. Intro question

II. Issue Environment (15 minutes/30 minutes)
   A. Right Direction/Wrong Track
   B. Most Important Problem facing your area
      1. Is it being addressed?

III. Traffic/Transportation (15 minutes/45 minutes)
   A. What do you think/feel when I say Traffic
      1. What's the problem
      2. What's the solution
   B. What do you think of when I say Transportation?
         a) Roads
         b) Highways
         c) Local streets
      2. Public Transportation
         a) Buses
         b) BART
         c) Light Rail
   C. What funds transportation projects now?
      1. Have you heard of anything recently about transportation funding?
      2. What about in the last couple of years?

IV. Regional Smart Carpool Lanes (30 minutes/1 hour 15 minutes)

   A. There is a proposal under consideration to complete the carpool lane system throughout the Bay Area so that every mile of every major highway in the region would have a carpool lane. In addition to allowing people to carpool anywhere in the

region, this proposal also would significantly expand the regional express bus network, allowing rapid express bus service to run all over the nine counties in the Bay Area with frequent service and without getting stuck in traffic. In order to avoid raising taxes, the system would be financed by allowing single occupant vehicles to use the carpool lanes when there was space in them for a fee which would be assessed using the same fast track pass that people use when they cross a Bay Area bridge. That way it could be done without building toll booths or slowing down traffic.

1. Good idea or bad idea?
2. What do you like about it?
3. What do you dislike about it?
4. Who would benefit?
5. Who would not benefit?
6. Expanding the carpool lanes
    a) Good idea/Bad idea
7. Expanding Express Bus service
    a) Good idea/Bad idea

V. Smart Carpool Lanes (30 minutes/1hour 45 minutes)

A. Good idea/Bad idea

B. What do you like about it?

C. What do you not like about it?

D. Who would benefit?

E. Who would not benefit?

F. What would the impact be on the carpool lane?

G. Who would use it?
    a) Rich people
    b) Busy people
    c) People who cannot afford to be late to their destination
    d) Most people occasionally

H. Would you use it?
    1. When?

I. How much should it cost?
    a) Should it cost different amounts during different times of day?

J. What about people who can't afford it?
    1. Should they get a discount?

2. Should they be able to earn credits towards using the express lane when they use the slow lanes?

K. How should the proceeds be used?

1. Pay for construction of carpool lanes
2. Pay for better alternatives to driving
   a) Express Bus service
   b) BART
   c) Other
3. Pay for construction of additional mixed use lanes

VI. 580/680 corridor (15 minutes/2 hours)

A. How do you get to work?

1. What is your primary commute?
   a) Has your commute gotten better or worse over the last couple of years?
   b) What is the worst part of your commute?

B. What comes to mind when I say Interstate 580?

C. What comes to mind when I say Interstate 680?

1. Has traffic gotten better or worse in the last couple of years?
2. How could your commute be improved?
   a) Widen highway
   b) Carpool lanes
   c) Better transit

Appendix D
Public Opinion Survey Questionnaire

1.	RESPID		
2.	SEX	Male	49
		Female	51

Hello, my name is _____, may I speak with _____? Hello, my name is _____, and I'm conducting a survey for The Evans/McDonough Research Company to find out how the people of your area feel about some of the different issues facing them. We are not trying to sell anything, and are collecting this information on a scientific and completely confidential basis.

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3. Just to make sure I'm calling the right place, can you please tell me what county you live in?

Alameda----------> (CONTINUE)	100
Else----------> **(TERMINATE)**	

4. Do you think that things in your area are generally going in the right direction or do you feel things have gotten pretty seriously off on the wrong track?

Right Direction	54
Wrong Track	36
(Don't know)	11

5. What do you think is the most pressing issue of major concern in the County?

(PROBE FOR THREE RESPONSES)

Traffic/Transit/Transportation	27
Education/Schools	25
Jobs/Unemployment	20
Crime/Violence	21
Lack of affordable housing	15
Healthcare	13
Growth/overpopulation	5
Gas prices	5
Homelessness	4
Budget cuts	4
Drugs	4
Taxes	3
Not enough police	3
Cost of living	3
Gangs	3
Environment/Air pollution	2
Poverty	2
Public services/Infrastructure	2
Presidential election	1
Water supply	1
War in Iraq	1
Casino/Gambling issues	1
Not enough programs for kids	1
Other	9
Nothing	0
Don't know	6

6. Thinking about growth and development for a minute, imagine a scale that runs from 1 to 7 where 1 means very pro growth and 7 means very anti-growth. Where would you place yourself on that scale?

1	**2**	**3**	**4**	**5**	**6**	**7**	**|**	**8**	**Mean**
Very Pro Growth					**Very Anti-Growth**		**| (Don't Know)**		
12	8	18	20		20	10	9	4	3.96

7. Thinking back over the last few years, would you say the traffic has gotten better or gotten worse?

Better	10
Worse	82
(Same)	6
(Don't Know)	3

8. Thinking ahead to the next year or so would you say that traffic is going to get better or get worse?

Better	6
Worse	86
(Same)	5
(Don't Know)	3

I'm going to read you the names of a number of different kinds of traffic lanes. For each one please tell me if you have a strongly favorable, somewhat favorable, somewhat unfavorable or strongly unfavorable opinion.

SCALE: 1. Strongly Favorable 2. Somewhat Favorable 3. Somewhat Unfavorable 4. Strongly Unfavorable 5. (Can't Rate)

(RANDOMIZE Q9-Q15)

	1	**2**	**3**	**4**	**5**
9.	Carpool Lanes;				
	66	25	3	4	3
10.	HOV Lanes or High Occupancy Vehicle Lanes; (H – O – V Lanes)				
	35	27	7	8	23
11.	HOT Lanes or High Occupancy Toll Lanes; (HOT Lanes)				
	19	21	16	17	27
12.	Managed Lanes;				
	8	17	11	6	58
13.	Smart Carpool Lanes;				
	31	23	6	4	36
14.	Express Lanes;				
	35	33	6	4	23
15.	FAIR Lanes;				
	9	16	10	9	56

(END RANDOMIZE)

There is a proposal under consideration to create a regional Smart Carpool Lane system that would complete and connect carpool lanes on every major highway in the nine county Bay Area region and significantly expand the regional express bus network to utilize the complete system of carpool lanes and provide frequent and reliable express bus service that won't get stuck in traffic. The system would be financed by allowing people who drive alone to use the Smart

Carpool lanes for a fee using the same FasTrak **(Fast Track)** pass currently used to pay tolls on Bay Area bridges.

16. Given what you have heard about this project, please tell me whether you support or oppose it using a scale, where one means that you strongly oppose this proposal and seven means that you strongly support it.

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Mean**
Strongly oppose				**Strongly support**			**(DK)**	
16	7	7	12	17	15	25	1	4.56

17. What would you say is the main reason you support or oppose this proposal?
(OPEN END, TAKE ONE RESPONSE)

Support:	
Alleviates Traffic	25
Support/Encourage use of public transport/carpooling	9
Quicker/Faster commute	9
Benefits single drivers who can't carpool/use transit	5
Generates revenue/Pays for itself, not paid by taxpayers	4
Good idea – general	3
Connecting carpool lanes	3
People who want to use can pay	2
Alleviate pollution/Environmental reasons	2
Fair/Equal access	1
I would use it	1
Oppose:	
Unfair to people who can't afford it	7
Already pay taxes, shouldn't have to pay more	6
Doesn't encourage carpooling/Defeats purpose of carpooling	5
Don't want to pay/Don't want toll roads	3
Won't alleviate traffic/Won't work	3
Confusing/Difficult to enforce/Added bureaucracy	1
Wouldn't generate enough income/Taxpayers would have to pay	1
Unfair – general	0
Other:	
All others	10
Need more information/details	1
Don't know	1

I'm going to describe several elements of this project. After each one, please tell me whether you support or oppose that element of the project using the same scale, where one means that you strongly oppose this element of the project and seven means that you strongly support it.

SCALE:	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Mean**
	Strongly oppose				**Strongly support**			**(DK)**	

(RANDOMIZE Q18-Q24)

18. Complete and connect carpool lanes on every major highway in the nine county Bay Area region.

8	2	3	6	13	16	50	2	5.63

19. Significantly expand the regional express bus network to utilize the complete system of carpool lanes

1	2	3	4	5	6	7	8	Mean
6	3	6	6	16	16	45	3	5.60

20. Provide frequent and reliable express bus service that won't get stuck in traffic.

1	2	3	4	5	6	7	8	Mean
4	3	5	2	10	17	58	2	5.96

SCALE: 1 2 3 4 5 6 7 | 8 Mean
Strongly oppose Strongly support | (DK)

21. Finance the system by allowing people who drive alone to use the carpool lanes for a fee.

1	2	3	4	5	6	7	8	Mean
22	9	7	8	13	13	27	2	4.28

22. The fee for people who drive alone would be collected just like FasTrak is when you cross a Bay Area bridge.

1	2	3	4	5	6	7	8	Mean
20	5	6	9	11	16	33	1	4.68

23. Carpools would still use the lane for free.

1	2	3	4	5	6	7	8	Mean
4	2	3	2	6	13	69	1	6.23

24. Access for people who drive alone to the Smart Carpool Lanes would be regulated to ensure that minimum speeds in the lane always exceeded 45 miles per hour for all drivers;

1	2	3	4	5	6	7	8	Mean
15	4	7	9	19	15	29	3	4.78

(END RANDOMIZE)

25. Given what you have heard about this project, please tell me whether you support or oppose it using the same scale, where one means that you strongly oppose this proposal and seven means that you strongly support it.

1	2	3	4	5	6	7	8	Mean
Strongly oppose				**Strongly support**			**(DK)**	
8	7	6	11	17	24	26	2	4.99

I'm going to give you some more information about Smart Carpool Lanes. After each item, please tell me whether knowing this makes you more likely to support or oppose implementing Smart Carpool Lanes in the Bay Area using the same scale, where one means that that information makes you much more likely to oppose Smart Carpool Lanes and seven means that you are much more likely to support Smart Carpool Lanes.

SCALE: 1 2 3 4 5 6 7 | 8 Mean
Much more likely to oppose Much more likely to support | (DK)

(RANDOMIZE Q26-Q32)

26. Smart Carpool Lanes utilize new technology to monitor traffic in carpool lanes and allow solo drivers to use the lane for a fee while guaranteeing a minimum speed of 45 miles per hour in the lane for all drivers;

1	2	3	4	5	6	7	8	Mean
19	6	7	10	19	15	23	1	4.45

27. Smart Carpool Lanes will have better separation from the rest of the roadway, with specific locations for entering and exiting the lanes, which will help in improve commute times and driving speeds;

1	2	3	4	5	6	7	8	Mean
10	3	7	11	21	19	28	1	5.01

28. Smart Carpool Lanes would give commuters a choice to pay for a faster commute when they need to get somewhere;

15	5	7	7	17	14	36	1	4.92

SCALE:

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Mean**
Much more likely to oppose				**Much more likely to support**			**(DK)**	

29. Smart Carpool Lanes are being used in San Diego and Houston, where they have helped reduce traffic congestion and are popular with commuters;

11	3	6	11	19	17	28	5	4.94

30. Smart Carpool Lanes would allow rich people to buy their way out of traffic;

36	10	5	14	9	7	19	1	3.49

31. Smart Carpool Lanes would cost too much for poor people to use them;

26	11	14	12	11	8	16	2	3.59

32. Smart Carpool Lanes will pay for the costs of completing and connecting carpool lanes on every major highway in the nine county Bay Area region;

13	3	6	10	21	16	29	2	4.90

(END RANDOMIZE)

33. Given what you have heard about Smart Carpool Lanes, please tell me whether you support or oppose creating a Regional Smart Carpool Lane system using the same scale, where one means that you strongly oppose this proposal and seven means that you strongly support it.

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Mean**
Strongly oppose				**Strongly support**			**(DK)**	
15	4	7	10	19	20	24	2	4.72

Some people have suggested a slightly different concept that they call Fair Lanes. The way that Fair Lanes would work is that low-income people who can't afford to use the express lane could earn credits towards using the express lane when they use the other freeway lanes.

34. Given what you have heard about this idea, please tell me whether you support or oppose it using the same scale, where one means that you strongly oppose this proposal and seven means that you strongly support it.

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Mean**
Strongly oppose					**Strongly support**		**DK)**	
26	7	12	13	15	10	14	3	3.70

35. What would you say is the main reason you support or oppose this proposal?
(OPEN END, TAKE ONE RESPONSE)

Support:

Fair/Allows low income to use lanes	17
Alleviates Traffic	11
Fair/Equal access - general	8
Equal access to roadways regardless of income	6
People who want to use can pay	3
Quicker/Faster commute	2
Good idea – general	2
Generates revenue/Pays for itself, not paid by taxpayers	1
I would use it	1
Support/Encourage use of public transport/carpooling	0
Alleviate pollution/Environmental reasons	0
Benefits single drivers who can't carpool/use transit	0

Oppose:

Confusing/Difficult to enforce/Added bureaucracy	15
Unfair to people who can't afford it	4
Doesn't encourage carpooling/Defeats purpose of carpooling	3
Won't alleviate traffic/Won't work	3
How will income level be proven/Fraud, lying to receive benefits	3
Unfair – general	3
Bad idea – general	2
Already pay taxes, shouldn't have to pay more	2
Don't want to pay/Don't want toll roads	1
Pollution/Environmental reasons	0

Other:

All others	8
Need more information/details	3
Neutral	1
Don't know	1

36. Do you think that this proposal is more fair or less fair than the Smart Carpool Lane system described earlier?

More fair	42
Less fair	35
(No difference)	11
(Don't know)	12

Another version of the Fair Lanes idea would give a significant discount to low income people who want to use the express lane.

37. Given what you have heard about this idea, please tell me whether you support or oppose it using the same scale, where one means that you strongly oppose this proposal and seven means that you strongly support it.

1	**2**	**3**	**4**	**5**	**6**	**7**	**8 (DK)**	**Mean**
Strongly oppose						**Strongly support**		
21	6	11	14	16	12	17	2	4.03

38. What would you say is the main reason you support or oppose this proposal?
(OPEN END, TAKE ONE RESPONSE)

Support:	
Fair/Allows low income to use lanes	24
Fair/Equal access - general	9
Alleviates Traffic	3
Good idea – general	3
Sliding scale based on income/Paying something, not free	2
Quicker/Faster commute	1
Easier to understand/implement than credits	1
Miscellaneous positive	2
Oppose:	
Unfair/Making some pay and not others	6
Confusing/Difficult to enforce/Added bureaucracy	6
How will income level be proven/Fraud, lying to receive benefits	6
Income should not be a criterion for freeway access	5
Doesn't encourage carpooling/Defeats purpose of carpooling	3
Won't alleviate traffic/Creates more traffic	3
Nobody should get a discount/Everyone should pay the same	3
Still a burden on low income	2
Already pay taxes, shouldn't have to pay more	2
Opposed to toll roads/All roads should be free	1
Miscellaneous negative	4
Other:	
All others	9
Need more information/details	3
Don't know	3
Nothing	0

39. Do you think that this proposal is more or less fair than the Smart Carpool Lane system described earlier?

More fair	47
Less fair	32
(No difference)	12
(Don't know)	9

I'd like to ask you a few questions for statistical purposes only.

40. Thinking about the environment for a minute, imagine a scale that runs from 1 to 7 where 1 means you are not an environmentalist at all and 7 means you are a very strong environmentalist. Where would you place yourself on that scale?

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Mean**
Not environmentalist				**Strong Environmentalist**			**DK**	
2	4	6	16	29	18	24	1	5.20

41. What is the last grade you completed in school?

Some grade school	0
Some high school	3
Graduated High School	13
Technical/Vocational	2
Some College	25
Graduated College	35
Graduate/Professional	23
(Don't Know/Refused)	-

42. Do you rent or own your home or apartment?

Rent	40
Own/buying	58
(Other)	2
(Don't Know)	-

43. In terms of your job status, are you employed, unemployed but looking for work, retired, a student, or a homemaker?

Employed	69
Unemployed	5
Retired	15
Student	8
Homemaker	1
(Other_____)	2
(Don't Know)	0

(IF Q43=2 or 3 or 4 or 5 or 6 or 7, SKIP TO Q47)

44. What is your occupation?_____

(Professional)	48
(White Collar Manager)	16
(White Collar Clerk)	12
(Service)	7
(Farmer)	-
(Unskilled Blue Collar)	3
(Skilled Blue Collar)	12
(Other_____)	3
(Don't Know/Refused)	1

45. What city do you work in?

Oakland	25
San Francisco	11
Fremont	8
Berkeley	7
Hayward	6
Livermore	4

Pleasanton	4
San Jose	2
Newark	2
Alameda	2
Concord	2
Emeryville	1
Castro Valley	1
San Leandro	1
Dublin	1
Redwood City	1
Richmond	1
San Rafael	1
San Ramon	1
Santa Clara	1
Sunnyvale	1
Union City	1
Bay Area – unspecified	2
DK/Ref	1
All others	13

46. On the average day, how long would you estimate that it takes you to get to work?

Under 10 minutes	21
10 to 30 minutes	41
30 to 60 minutes	32
Over 60 minutes	5
(DK/Refused)	1

(RESUME ASKING EVERYONE)

47. What mode of transportation do you use most often to get to work, go to school, volunteer or do some combination of these activities? Do you… (single response)

Drive by yourself	63
Ride the bus	5
Carpool or vanpool	8
Ride BART	10
Ride a bicycle	4
Ride a motorcycle	1
Ride the ferry	-
Use special transportation services for seniors & people with disabilities	0
Walk	5
(Use some other mode)	5
(DK/Refused)	-

48. In a typical week, how often do you drive on Interstate 580 or 680 to get to work, school, volunteer activities or other destinations?

Once a week or more	29
3 times a week or more	35
Once a month or more	14
A couple of times a year	10
(Don't Know)	12

49. What is your age?

18-24	11
25-29	13

30-34	11
35-39	11
40-44	12
45-49	11
50-54	8
55-59	7
60-64	5
65+	12
(Refused)	0

50. What race would you classify yourself as-- African-American, White, Hispanic, Asian or something else:

African-American/Black	12
White/Caucasian	53
Hispanic/Latin-Am	10
Asian/Asian-Am	15
(Other_____)	4
(Refused)	6

51. Do you currently or have you ever used the electronic FasTrak pass to cross a Bay Area bridge?

Have used FasTrak	28
Have not used FasTrak	72
(Don't know)	-

52. Please stop me when I read the category that includes your annual household income before taxes: less than $15,000, at least 15,000 but less than 25,000, at least 25,000 but less than 35,000, at least 35,000 but less than 50,000, at least 50,000 but less than 75,000, at least 75,000 but less than 100,000, or more than 100,000?

<$15,000	8
$15,000-24,999	9
$25,000-34,999	10
$35,000-49,999	12
$50,000-74,999	15
$75,000-99,999	14
>$100,000	21
(Refused/DK)	10

THANK YOU

**** end ****