METROPOLITAN
TRANSPORTATION
COMMISSION

Summary of I-680 North Express Lanes Project in Contra Costa County Environmental Technical Analyses: Greenhouse Gas Emissions, Vehicle Miles Traveled, and Use by Low-Income Populations

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Section 1: Overview

This report, prepared solely by the Metropolitan Transportation Commission (MTC), summarizes technical analyses of greenhouse gas (GHG) emissions effects, vehicle miles traveled (VMT) effects, and use of express lanes by low-income populations of the Interstate 680 (I-680) North Express Lanes Project. The technical analyses (Analyses) were conducted for environmental review in accordance with the California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA). Caltrans approved the technical analyses as the CEQA and NEPA lead agency. The analyses follow the formats and procedures outlined in Caltrans' Standard Environmental Reference. The Categorical Exemption/Categorical Exclusion (CE/CE) determination signifies that the actions of the Project are of such a nature that they would not have a significant effect on the human environment either individually or cumulatively.

This summary was prepared by MTC in accordance with the Settlement Agreement dated June 18, 2014 among the MTC and the Association of Bay Area Governments (ABAG), and Communities for a Better Environment and the Sierra Club. This summary is solely the work of the MTC. Caltrans was not involved in the production of this summary.

1.1 Project Description

The Analyses state that the Contra Costa Transportation Authority (CCTA), in cooperation with the Metropolitan Transportation Commission (MTC), the California Department of Transportation (Caltrans) and the Federal Highway Administration (FHWA), proposes to convert approximately 11 miles of high-occupancy vehicle (HOV) lanes on Interstate 680 (I-680) into express lanes (Project). Express lanes allow single occupancy vehicles to use HOV lanes by paying a toll that is adjusted dynamically based on congestion. The existing southbound I-680 HOV lane would be converted to an express lane from just south of Marina Vista Avenue in Martinez to just south of Treat Boulevard to Rudgear Road. (Figure 1). [1]

In the southbound direction, the CCTA I-680 North Express Lane would connect with the MTC I-680 South Express Lane, which extends from Rudgear Road to Alcosta Boulevard. Once the Project is complete and open to traffic, a continuous I-680 southbound express lane would extend from Marina Vista Avenue to nearly the I-580 Interchange. This would require the Project to modify the southbound toll collection zones and the associated signing, lighting, and electronic tolling equipment established by the MTC I-680 South Express Lane project from Rudgear Road to El Cerro Boulevard.

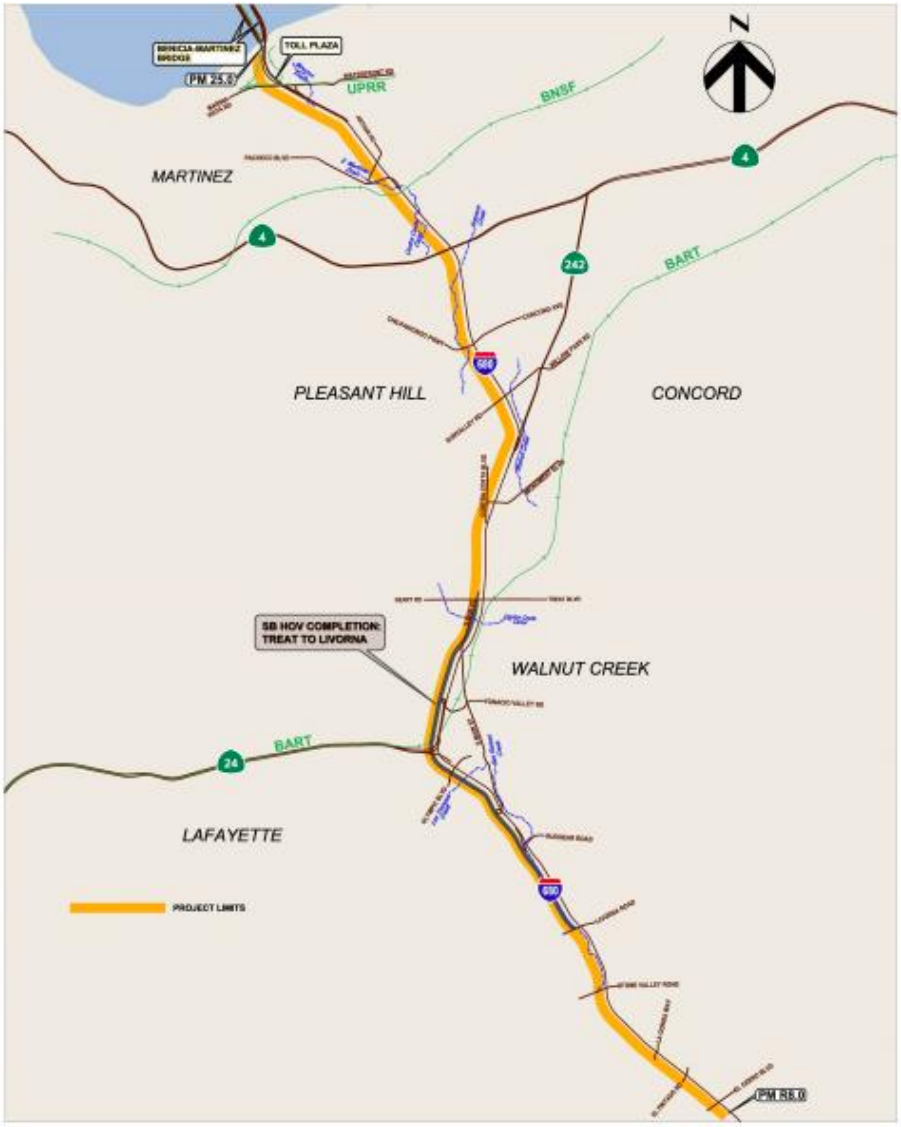
The Analyses state that consistent with other express lanes that are currently being planned and implemented in the Bay Area, this Project would generally allow for continuous access between the express lane and the adjacent mixed-flow (general purpose) lanes. In areas where substantial amounts of merging into and out of the express lane is expected, restricting access between the express lanes

[1] The northbound direction of the I-680 project was analyzed as part of the Air Quality Conformity Analysis and the Traffic Operations Analysis Report. The northbound direction of the I-680 project was not included as part of this section of the summary, as it was not included in the project environmentally cleared.

and the mixed-flow lanes ("restricted access") can be beneficial to reduce congestion and improve safety. There are a few locations in the southbound direction along the I-680 corridor where restricted access is planned to ensure that merging movements into and out of the express lanes flow smoothly and support optimal traffic operations.

The Project is listed in the MTC's 2013 Regional Transportation Plan (RTP), and MTC's financially constrained 2015 Transportation Improvement Program (TIP). The Project is intended to shift SOVs choosing to pay a toll from the general purpose lanes to the HOV lanes, thereby optimizing the use of the HOV lanes and offering a more reliable travel time option.

Figure 1: Project Limits Map: I-680 North Express Lane Project
(Figure 1-1 from the Community Impact Assessment)



1.2 Environmental Review

As the lead agency under NEPA and CEQA, Caltrans found the Project to qualify as a Categorical Exemption under CEQA and Categorical Exclusion under NEPA. The State Clearing House number 2017088427 for the Notice of Exemption was posted August 21, 2017. See: http://www.ceqanet.ca.gov/.

Section 2: Greenhouse Gas Emissions Effects

This section summarizes the results of the analysis of greenhouse gas emissions (GHG) as reported in the "Air Quality Conformity Analysis, I-680 North Express Lanes Project" (September 2015). The Air Quality Conformity Analysis (Analysis) contains the information that is required to make an air quality conformity determination for the Project[2] and is consistent with information published by FHWA related to Project-Level Conformity Analysis, the Standard Environmental Reference (SER) Air Quality Conformity Findings Checklist, applicable U.S. Environmental Protection Agency (EPA) project-level analysis guidance, the Transportation Conformity Regulations at 40 CFR 93 Subpart A, and Section 176(c) of the Federal Clean Air Act (42 USC 7506(c)).

2.1 Methodology

The GHG analysis methodology is described in Chapter 4 of the Analysis. The Analysis states that efforts devoted to GHG emissions reduction and climate change research and policy have increased dramatically in recent years. These efforts are primarily concerned with emissions of GHG related to human activity that include carbon dioxide (CO_2), methane, nitrous oxide, tetrafluoromethane, hexafluoroethane, sulfar hexafluoride, HFC-23 (fluoroform), HFC-134a (1,1,1,2-tetrafluoroethane), and HFC-152a (difluorothane).

The Analysis states that the Project is located in the San Francisco Bay Area Basin, which falls under the jurisdiction of the Bay Area Air Quality Management District (BAAQMD). The conformity process does not address pollutants for which the area is attainment/unclassified, mobile source air toxins, other toxic air containments or hazardous air pollutants, or greenhouse gases.

2.2 Analysis Results

2.2.1 Context

The Analysis states that an individual project does not generate enough GHG emissions to significantly influence global climate change, and global climate change is a cumulative impact. This means that a project may participate in a potential impact through its incremental contribution combined with the contributions of all other sources of GHG. In assessing cumulative impacts, it must be determined if a project's incremental effect is "cumulatively considerable." (CEQA Guidelines sections 15064(i) (1) and 15130). To make this determination, the incremental impacts of the project must be compared with the effects of past, current, and probable future projects. The Analysis states that to gather sufficient information on a global scale of all past, current, and future projects in order to make this determination

[2] The Analysis included the conversion of the existing HOV lane to an express lane in the northbound direction of the I-680 from the I-680/State Route 242 (SR 242) interchange to approximately Marina Vista Avenue in addition to the Project defined in Section1. The northbound direction of I-680 was not included in the Project environmentally cleared.

is a difficult, if not impossible task. The Analysis states that Caltrans has created and is implementing a Climate Action Program to address GHG emission reduction and climate change.

The Project was included in the regional emissions analysis conducted by MTC for the conforming Transportation 2040 Plan Bay Area (Regional Transportation Plan (RTP)). FHWA determined that the RTP conforms to the State Implementation Plan. The Project is also included in the Federal 2015 Transportation Improvement Program (TIP), prepared by MTC. The 2015 TIP was determined to conform by FHWA and the Federal Transit Administration (FTA) on December 15, 2014.

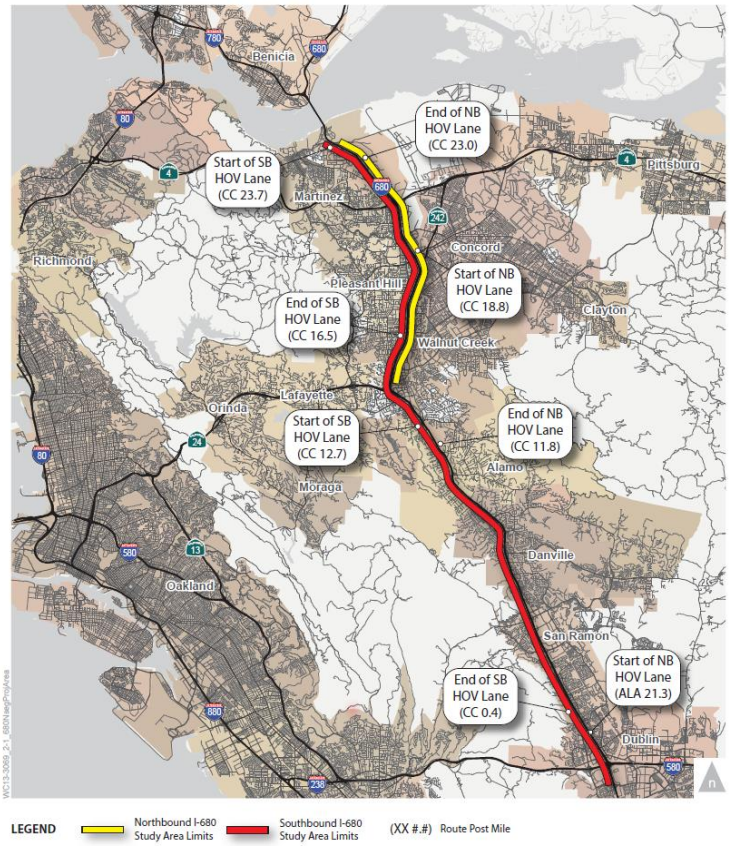
2.2.2 Summary

The Project will not cause an increase in vehicle miles traveled and would not result in any long term change to GHG emissions.

Section 3: Vehicle Miles Traveled (VMT) Effects

This section summarizes VMT estimates as reported in the "Final Traffic Operations Analysis Report: I-680 North Segment Express Lanes PA/ED" (November 2015). The Traffic Operations Analysis Report (TOAR) documents the existing, opening year and 20-year future conditions (with a 2040 horizon year) related to transportation with and without the I-680 North Express Lanes (Project).[3] For purposes of the traffic study, the geographic area considered extends beyond the project limits in order to capture the effects of traffic in the surrounding areas on the proposed Express Lanes. The TOAR states that the traffic study area is in the northbound direction on I-680 from the Ygnacio Valley Road interchange to the Benicia-Martinez Bridge, and in the southbound direction on I-680 from the Benicia-Martinez Bridge to the Stoneridge Drive interchange (Figure 2). The TOAR includes VMT as one of the measures of effectiveness (MOEs), but it is not the single focus of the report.

Figure 2: I-680 North Express Lanes Study Area Limits
(Figure 2-1 from the TOAR)



3.1 Methodology

[3] The TOAR included the conversion of the existing HOV lane to an express lane in the northbound direction of the I-680 from the I-680/State Route 242 (SR 242) interchange to approximately Marina Vista Avenue in addition to the Project defined in Section1. The northbound direction of I-680 was not included in the Project environmentally cleared.

The traffic analysis methodology is described in Sections 2.4 and 4 and Appendix D of the TOAR. The TOAR states that freeway analyses were conducted using procedures and methodologies consistent with the *Highway Capacity Manual 2010* (Transportation Research Board, 2011) and applied using VISSIM traffic analysis software. The existing conditions traffic analysis model was validated to observed traffic counts, travel times, bottleneck locations and queues prior to extracting measures of effectiveness from the model. The procedures used are consistent with *Traffic Analysis Toolbox Volume III: Guidelines for Applying Traffic Micro-simulation Modeling Software* (FHWA, 2004).

The TOAR states that VMT, one of the MOEs, was computed with VISSIM models to quantify traffic operations of the I-680 study corridor. The system-wide MOEs are presented for the four-hour study period to provide a better understanding of overall traffic operations during each study period. VMT is a measure of the total vehicle throughput of the corridor. This measure takes into consideration the actual volume served versus the demand and the trip lengths of those vehicles.

The TOAR states that Contra Costa Transportation Authority (CCTA) serves as the designated Congestion Management Agency for Contra Costa County and in that capacity is responsible for maintaining a travel demand model and database that is consistent with MTC's model and database. The CCTA Model was used in the traffic forecast analysis for the TOAR. The CCTA Model is a regional travel demand model that covers the entire Bay Area, with higher level of geographic detail within Contra Costa County. The model receives its demographic inputs from the Association of Bay Area Governments (ABAG) regional land use projections, and produces estimates of regional travel flows based on a standard four-step modeling process. To ensure a high level of confidence in the forecasting process, the CCTA Model was first refined and validated within the Project study area. The TOAR states that the CCTA Model was updated to 2013 conditions and was validated to a level well within the application model validation guidelines. The analysis scenarios used in the reports are opening year (2020) No Build, opening year (2020) with Express Lanes, horizon year (2040) No Build and horizon year (2040) with Express Lanes.

3.2 TOAR Analysis Results

The estimated VMT associated with the Project is reported in Chapter 5 of the TOAR in Sections 5.2.1.4 and 5.2.2.4, which considers the MOEs for the opening year (2020), and in Chapter 6 in Sections 6.2.1.4 and 6.2.2.4, which considers the MOEs for the horizon year (2040).

3.2.1 Existing Year (2013) VMT Forecasts

Existing year (2013) VMT forecasts are shown with other MOEs in Appendix A; Tables 3-11, 3-12, 3-13, & 3-14.

3.2.2 Opening Year (2020) VMT Forecasts

The TOAR summarizes the VMT findings with other MOEs. The TOAR states that for the opening year (2020) northbound a.m. peak study period, the MOEs would remain the same because there is no congestion in the corridor, thereby the addition of an Express Lanes would likely result in little to no use. The TOAR states that for the opening year (2020) northbound p. m. peak study period the VMT would

remain the same in the No Build and Express Lane conditions because through there is little congestion, the Express Lane would not relieve the upstream bottlenecks, giving no benefit to tolled drivers.

The TOAR states that during the southbound a.m. and p.m. study periods, the volume served and vehicle miles traveled remains relatively unchanged (about 1%) with the Express Lane. [Opening year (2020) VMT forecasts are shown with other MOEs in Appendix A; Tables 5-1, 5-2, 5-4, & 5-5].

3.2.3 Horizon Year (2040) VMT Forecasts

The TOAR states that for the horizon year (2040) northbound a. m. study period the MOEs would remain the same because there is no congestion in the corridor, thereby the addition of an Express Lane would likely result in little to no use. For the horizon year (2040) northbound p. m. study period, volume served, VMT, and VHD would remain similar in 2040 No Build and Express Lane conditions because overall congestion remains similar between the two scenarios.

The TOAR states that for the horizon year (2040) southbound a. m. and p. m. study periods the volume served and VMT remains relatively unchanged with the Express Lane as a result of congestion relief which allows more drivers to reach their destination during the analysis period. [Horizon year (2040) VMT forecasts are shown with other MOEs in Appendix A; Tables 6-1, 6-2, 6-4, & 6-5].

Section 4: Use of Express Lanes by Low-Income Populations

This section summarizes information on the use of the Project by low-income populations as reported in the "Interstate 680 North Express Lanes Project Community Impact Assessment" (August 2016).

The Community Impact Assessment (CIA) addresses use of the express lanes by low-income populations to the degree it informs the main purpose of identifying disproportionate and adverse effects on minority or low-income populations, also referred to in this section as "Environmental Justice (EJ) populations".[4] Benefits of the Project and the public engagement activities are also discussed in the CIA. The following aspects of the analysis include information that addresses use of the Project by low-income populations:

- Summary of the current travel patterns of low-income populations in the study area. (Section 4. 4: Existing Transportation Travel Patterns and Conditions, CIA)
- Analysis of the project effects, which discusses potential future use of the Project by low-income populations, considering current travel patterns, express lane design and operations, benefits of express lanes, and willingness and ability to pay to use the lanes. (Chapter 4: Environmental Justice, CIA)

4. 1 Methodology

4. 1. 1 Identification of Low-Income Populations

Three study areas are defined and considered in the CIA for the Project:

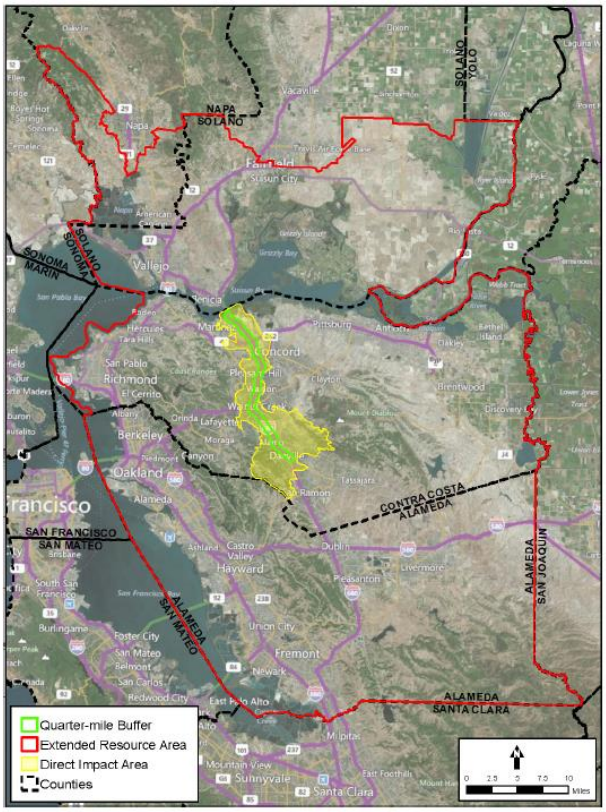
Direct Impact Area: This is defined as the area in close proximity to the proposed Project, and consequently includes the population most likely to experience any disproportionate adverse impacts of the physical improvements associated with the Project. The Direct Impact Area included all census tracts within one-quarter mile of the Project (Figure 3).

Extended Resource Area: The Extended Resource Area is included to consider the potential impacts to the likely users of the Project. While it cannot be determined exactly who will be using the express lanes and from where they will be traveling, for the purposes of the analysis, based on existing trip patterns, all census tracts that are located within 15 miles of the Project limits[5], as well as all of Alameda and Contra Costa Counties, are included in the Extended Resource Area (Figure 3).

[4] The CIA states that one of the principles of environmental justice is to ensure the full and fair participation by all potentially affected communities in the transportation decision-making process. All projects involving a federal action must comply with Presidential Order (EO) 12898, which directs federal agencies to take the appropriate and necessary steps to identify and address disproportionately high and adverse effects of federal projects on the health or environment of minority or low-income populations. In response to EO 12898, the U.S. Department of Transportation (USDOT) issued Order 5610.2, Order to Address Environmental Justice in Minority Populations and Low-Income Populations.
[5] The 15-mile radius to the north captures one block group in Sacramento County; however this block was not ultimately included in the ERA for the analysis done in the CIA.

Region of Comparison: The CIA states that a Region of Comparison is necessary in order to determine if Project-related adverse impacts are disproportionate in comparison to the greater area. The Region of Comparison is comprised of Contra Costa, Alameda, Napa and Solano counties.

Figure 3: Direct Impact Area and Extended Resource Area
(Figure 4-1 from the CIA)



The CIA states that MTC defines low-income individuals as individuals whose household income falls below 200 percent of the federal poverty limit. MTC suggests examining zones where 30 percent or greater of the total population is low-income. The CIA takes a comprehensive look at low-income populations in the corridor by both identifying census block groups where 30 percent or more of the population is below 200 percent of the poverty level as well as comparing populations in the direct vicinity of the Project to those in the overall region.

The CIA states that in the Direct Impact Area, 19.9 percent of the population is below 200 percent of the poverty level. The Extended Resource Area and Region of Comparison have a greater percentage of low-income populations than the Direct Impact Area at 26.9 and 27.0 percent, respectively (Table 1).

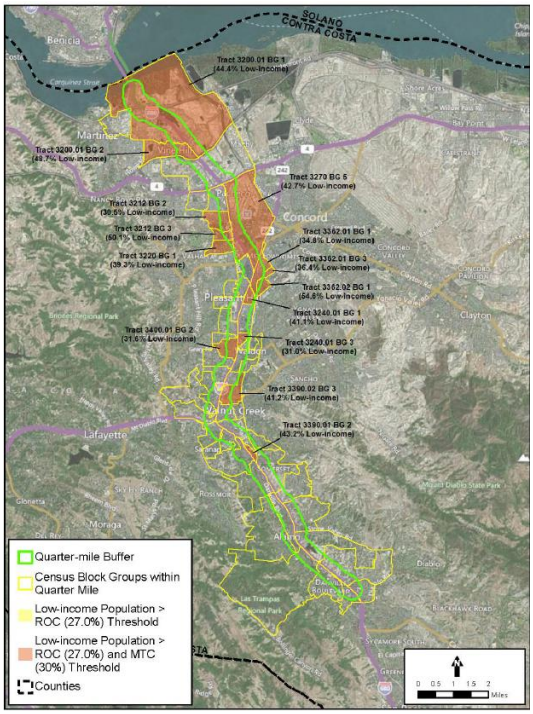
Table 1: Low-Income Breakdown in the Direct Impact Area, Extended Resource Area, and Region of Comparison
(Table 4-2 from the CIA)

Geography	Population	Above 200% of the Poverty Level	Below 200% of the Poverty Level ("Low-Income")
Direct Impact Area	89,204	71,462	17,742
	100%	80.1%	19.9%
Extended Resource Area	2,817,616	2,058,817	758,799
	100%	73.1%	26.9%
Region of Comparison	3,147,241	2,298,188	849,053
	100%	73.0%	27.0%

Source: U.S. Census Bureau, 2010 – 2014 American Community Survey 5-Year Estimates Table C17002: Ratio of Income to Poverty Level in the Past 12-Months

Figure 4 shows the 55 census block groups within the Direct Impact Area. Of these, 14 block groups have populations with low-income percentages that exceed the low-income population percentages in the Region of Comparison (27.0 percent). These fourteen block groups also exceed the low-income threshold established by MTC of 30 percent and are shaded in orange/dark red in the figure. These areas with high concentrations of low-income populations are located in the northern and central portions of the corridor in the areas around the Benicia Bridge, and through Pacheco, Concord, Pleasant Hill, and several areas in Walnut Creek.

Figure 4: Low-Income Population Concentrations in the Direct Impact Area
(Figure 4-3 in the CIA)



4. 1. 2 Data Sources

Discussion of the use of express lanes by low-income populations in the CIA is informed primarily by the following data sources:

- Data from the Census Transportation Planning Package (CTPP), U. S Census Bureau's American Community Survey, 5-year Estimate (2006-2010) on population and commute travel characteristics. This data is used to identify areas with concentrations of low-income populations, and to understand how low-income populations travel today.
- Results from outreach and engagement directed at low-income and minority populations using focus group and intercept surveys in multiple express lanes corridors, including I-680.
- Data available on use of express lanes in operation throughout the United States.

The CIA includes a summary of MTC's outreach and engagement efforts throughout Alameda, Contra Costa, and Solano counties for the overall Regional Express Lane Network, including the I-680 corridor. The data gathered from communities of minority and low-income populations included: travel behavior, perceptions about express lanes, ability and willingness to pay to use express lanes, and any potential barriers to using express lanes. The outreach effort included intercept surveys and focus group meetings. A total of 132 intercept surveys, available in English, Spanish, and Chinese, were conducted at six locations that are typically frequented by a large and diverse number of people from November 10, 2012 to December 1, 2012. Six focus groups were conducted between November 5, 2012 and December 7, 2012 at various community-based organizations in Alameda, Contra Costa and Solano counties.

Seventy-one percent of the focus group participants provided income information, and 44 percent of the participants reported that their income is below 200 percent of the poverty level, qualifying them as "low-income", based on the definition used in the CIA. Eighty-two percent of the intercept survey participants provided income information, and 40 percent of the participants reported their income is below 200 percent of the poverty level, qualifying them as "low-income".

4. 2 Analysis Results

The transportation impacts, economic impacts and benefits of the Project to EJ populations is reported in Chapter 4 of the CIA. The CIA concludes that the Project will not result in disproportionate adverse transportation or economic impacts; and will provide a benefit by providing a choice to low-income populations.

4. 2. 1 Summary

Transportation Impacts: The CIA concludes that operation of the Project and the options it provides to drivers along the project freeways would affect transportation usage; however, there is no evidence to suggest that the express lanes will in any way substantially degrade existing travel choices. The Project will improve transportation operations along these freeways by maximizing the capacity of the system by providing free HOV carpool lanes and allowing solo drivers access to the lanes for a fee. For drivers opting to pay the fee to use the carpool lane, they will experience less congestion and a decrease in

travel time. This benefit of the Project is available to all users; however, this option for EJ populations may have great benefit at times when their travel is very time-sensitive and the low fee to reach their destination sooner will ultimately be less than the cost of lost wages or late fees at a childcare center. There would be improvements in travel time with the proposed project to travelers within the general purpose lanes. Therefore, the CIA states the Project will not result in disproportionate adverse transportation impacts to minority and low-income populations.

Economic Impacts: The CIA states that to take advantage of the transportation benefits provided by the Project, a solo driver must incur a fee. The data and analysis presented in Chapter 4 reveal that most people understand this benefit; however, the financial hardship associated with obtaining a toll tag and paying the fee to access the express lane is dependent on income levels. Similar to other agencies that have implemented express lanes across the country, the MTC Express Lane Program that includes the Project allows customers to obtain a toll tag and pay the fees in several ways. Lower-income drivers who may lack a credit card or bank account would still have alternative means of obtaining a toll tag and paying fees to access the express lane. For lower-income drivers who set up a toll account and choose to use the express lane, even only in emergencies, the fee is balanced with the potential larger cost of being late to a destination.

The CIA states that the choice to not use the express lane does not result in any financial impact to freeway users. Carpoolers will not be required to pay a fee to access the express lanes; nonetheless, they will be required to obtain a switchable toll tag so they can declare their eligibility to use the express lanes for free. The Project currently has a southbound carpool lane that will be converted to an express lane and the existing general purpose lanes will not change with the proposed project. The Project will allow carpoolers to take advantage of less congestion at bottlenecks and shorter commute times without fees. Solo drivers will still be able to use the general purpose lanes with the Project. Moreover, the potential exists for overall freeway operations to improve with the express lane; as more cars move from general purpose lanes to the express lane with additional capacity, drivers in general purpose lanes may experience less congestion. With improved freeway operations and less overall congestion, potential gasoline savings may be realized by all drivers, including lower-income and minority drivers who continue to use general purpose lanes.

The CIA states that the Project results in a number of potential benefits to low-income drivers as well as some potential economic impacts to lower-income drivers who may experience a financial hardship in obtaining a toll tag or using the express lane. Since the Project will provide a choice for solo drivers to access the express lane for a fee and carpoolers to access them for free, with no changes to the free general purpose lanes, low-income drivers who choose to use the facility will perceive benefits that outweigh the cost while low-income drivers who choose to not use the facility will experience no change.

4.2.2 Existing Transportation Travel Patterns & Conditions

Regional Commuting Patterns

The CIA states that for the purpose of identifying travel patterns, the Region of Comparison is used since this data is available at the county level. In the counties that comprise the Region of Comparison, the majority of workers age 16 and older are employed within their county of residence; however, there are a large number of workers who commute to other counties and many of these commuters likely use the I-680 corridor to access these jobs. Table 2 shows that about 80 to 90 percent of low-income workers in all counties are employed within their county. The CIA states that data was compiled from the Census Transportation Planning Package (CTPP) 5-year estimates from 2006 to 2010. Low-income data is only available from the CTPP for up to 150 percent of the poverty level, so that will be the basis of discussion for "low-income" populations in this section. In addition to the low-income workers that both live and are employed in Contra Costa County (84.8 percent of low-income workers), 5.9 percent of low-income workers living in Alameda County, 1.3 percent of low-income workers living in Napa County, and 5.7 percent of low-income workers living in Solano County work in Contra Costa County and likely use the corridor.

Table 2: Counties of Residence and Employment by Low-Income Status
(Table 4-4 from the CIA)

County of Residence		County of Employment				Total Workers in ROC [a]
		Alameda	Contra Costa	Napa	Solano	
Alameda	Total Workers	465,295	39,735	555	1,775	507,360
	Number of Low-Income Persons	54,670	3,450	40	110	58,270
	Low-Income Working in County (%)	93.8%	5.9%	0.1%	0.2%	100.0%
Contra Costa	Total Workers	92,600	280,060	1,330	7,445	381,435
	Number of Low-Income Persons	4,615	29,115	40	555	34,325
	Low-Income Working in County (%)	13.4%	84.8%	0.1%	1.6%	100.0%
Napa	Total Workers	1,280	1,580	47,520	4,410	54,790
	Number of Low-Income Persons	20	85	5,975	250	6,330
	Low-Income Working in County (%)	0.3%	1.3%	94.4%	3.9%	100.0%
Solano	Total Workers	11,725	19,895	10,825	109,340	151,785
	Number of Low-Income Persons	630	840	1,450	11,745	14,665
	Low-Income Working in County (%)	4.3%	5.7%	9.9%	80.1%	100.0%

Source: U.S. Census Bureau, CTPP Table 32100, ACS 2006-20010 5-year Estimates
a. Workers 16 and Older

Means of Transportation to Work

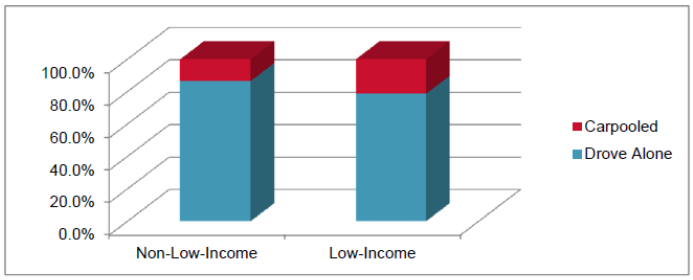
Table 3 shows the modes of transportation for commuters who are above and below 150 percent of the poverty level within the Extended Resource Area, as reported in the CIA. The CIA states that the table indicates that carpooling is more common for those below 150 percent of the poverty level, accounting for 14.3 percent of the low-income commuters. Figure 5 further shows that, overall in the Extended Resource Area, for commuters that ride to work in a personal vehicle (car, truck, or van), commuters below 150 percent of the poverty level are more likely to carpool than those at or above 150 percent of the poverty level.

Table 3: Modes of Transportation and Low-Income Status in Extended Resource Area (Table 4-7 from the CIA)

		Total Workers 16 Years & Over	Percentage who Drive Alone	Percentage who Carpool	Percentage who Use Transit[a]	Percentage who Use Another Mode[b] or Work at Home
Alameda	Non-Low-Income	620,421	66.5%	10.0%	12.3%	11.3%
	Low-Income	77,975	50.4%	12.4%	17.4%	19.9%
Contra Costa	Non-Low-Income	437,354	70.3%	11.0%	9.8%	8.9%
	Low-Income	47,462	59.5%	18.9%	9.0%	12.7%
Napa	Non-Low-Income	9,767	79.1%	13.7%	0.4%	6.8%
	Low-Income	693	76.0%	15.6%	0.0%	8.4%
Solano	Non-Low-Income	72,883	75.3%	13.9%	3.8%	7.0%
	Low-Income	9,439	70.6%	16.7%	2.2%	10.4%
Total Extended Resource Area	Non-Low-Income	1,140,425	68.6%	10.7%	10.7%	10.1%
	Low-Income	135,569	55.1%	15.0%	13.3%	16.6%

Source: U.S. Census Bureau, ACS 2010-2014 5-year Estimates Table B08122: Means of Transportation to Work by Poverty Status in the past 12-months
a. Transit includes bus, streetcar, trolley, subway, railroad, and ferry
b. Other modes include taxicab, motorcycle, bicycle, and walking

Figure 5: Carpooling versus Driving Alone for Low-Income Commuters in the Extended Resource Area (Figure 4-4 from the CIA)



Source: U.S. Census Bureau, ACS 2010-2014 5-year Estimates Table S08122: Means of Transportation to work by Poverty Status in the Past 12-Months

Travel Behavior

The CIA states that all intercept survey respondents indicated that they travel regularly on freeways in the region. Most respondents regularly drive alone, regardless of which freeways they use; however, approximately one-third of the respondents regularly carpool. Intercept survey respondents and focus group participants reported adjusting their driving behaviors to avoid using freeways during peak hours, including changing work schedules and departure times.

The CIA states that the intercept survey respondents reported that the majority of regular trips on affected freeways are long trips (a trip over five miles). Focus group participants also reported that although they do carpool, there are potential barriers to carpooling on a consistent basis. Participants stated that getting three people for a carpool is difficult and the HOV lane is not always faster and is often as congested as other lanes. Other participants expressed frustration with underutilized carpool lanes, admitting that they use carpool lanes as solo drivers.

Other Research on Travel Behavior

The CIA notes a study from Los Angeles, showing low-income drivers used HOV lanes at a higher rate than general purpose lanes on the I-10 and I-110 freeways. These results are in line with the higher carpooling rates for low-income travelers in the Extended Resource Area from the U. S. Census data.

4.2.3 Project Impacts

The CIA states that the Extended Resource Area was developed to encapsulate the typical users of the I-680 freeway and thus is considered in this evaluation.

Travel within the Corridor

Regional Commuting Patterns Impacts

The CIA states that the Project will not directly or indirectly change the propensity for EJ or non-EJ populations to change their commute or travel patterns within or outside of their county of residence. Therefore, the Project will have no impact on regional commuting patterns for the population overall, or for low-income or minority populations.

Means of Transportation to Work Impacts

The CIA states that tolled express lane projects give travelers the choice to change their behavior. Travelers who do not choose to change their behavior experience very little impact. The CIA states that the proposed Project does not have a direct effect on users' means of transportation to work; however, implementation of an express lane may influence the mode choices travelers make.

Travel Behavior Impacts

The CIA states that since a greater proportion of low-income and minority users already opt to carpool, the implementation of the proposed Project will not substantially affect their choice of means of transportation to work. The proposed Project is not likely to affect the travel behavior of low-income or minority groups any differently than the population as a whole. There is no specific research that shows that minority or low-income drivers are more likely to change travel behavior in order to pay less or realize the benefit of the express lanes; however, any monetary benefit gained by low-income populations would be a higher percentage of their income than the benefit to higher-income populations.

Traffic Congestion and Travel Time Impacts

The CIA states that a Traffic Operations Analysis Report (TOAR) prepared in November 2015 shows that the addition of the southbound express lane would reduce vehicle delay for almost all drivers in Year 2020 during the AM and PM peak periods. Travel speeds would increase for all users except PM peak HOV users (whose speeds would be the same under the No-Build condition) in the year 2020. By the year 2040, all users would continue to experience faster travel speeds, except for southbound PM peak HOV and SOV users (whose speeds would be the same under the No-Build condition). Increased travel

speed is a benefit for all users of the freeway, including low-income populations in the Direct Impact Area and Extended Resource Area.

Access and Connectivity

The CIA states that the Project would not impact access and connectivity of the regional system, so it would not result in direct or indirect regional accessibility impacts to minorities or low-income populations. When drivers enter the freeway, there will be appropriate signage to alert them to the fee for using the express lane and ample opportunity for them to access the lane in most locations. With the exception of two locations, there will be continuous unrestricted access from the start of the Express Lane (south of the Marina Vista on-ramp) to where it meets the Phase I Express Lane being constructed by MTC. There will be restricted access to the express lane from the SR-242 merge with I-680 to the North Main Street off-ramp, and from a half mile north of the Rudgear on-ramp gore to the Stone Valley Road on-ramp. These restricted access areas are located on stretches of the highway where merging conflicts are anticipated. Express lane users can bypass the two primary southbound bottlenecks located between North Main Street and SR 242 and between Stone Valley Road and El Pintado Road. The buffers reduce lane change friction between the general purpose lanes and express lane and provide more reliable travel times in the express lane than if access were unrestricted.

The CIA states that both restrictions are located in areas with EJ populations living nearby. In the case of the SR-242/North Main restriction, minority concentrations reside to the east of the northern end of the restricted area and low-income concentrations reside both to the east of the northern end and on both sides of the freeway in the central part of the restricted area. Although the buffers would delay some local drivers interested in using the express lane as an HOV or solo driver for a fee, including these EJ populations, from accessing the express lane or direct them to exit the lane earlier, weaving and merging maneuvers would be reduced resulting in safer travel and faster travel speeds through the corridor. In addition, the proposed project results in less congestion in the general purpose lanes over the existing conditions, reducing delay for drivers in the general purpose lanes (Fehr and Peers, 2015). Any delays in the receipt of the benefits of the express lane would be borne by all users, and not disproportionately by EJ users. Moreover, the restricted access area results in a benefit of improved travel safety and reliability to both express lane users and general purpose lane users.

The CIA states that in the case of the Rudgear/Stone Valley restriction, low-income concentrations reside immediately northeast of the restricted area. Drivers in this neighborhood needing to enter southbound I-680 have the choice of entering at Rudgear Road, which would delay their ability to enter the express lane until Stone Valley Road, or at South Main Street. These populations would not be subject to an early exit from the express lane to exit the freeway. In addition to the benefit of safer and faster travel as noted above, access to and from the express lane for this EJ community would not be impacted.

The CIA states that for the EJ populations residing near the locations with the restricted access areas, the delay in the receipt of the benefit of the express lane may be considered a minor impact since the freeway interchanges they may typically use may preclude them from entering the express lane

immediately. However, these locations are also the segments of the freeway corridor experiencing the heaviest congestion and merging conflicts. Without the buffers and restricted access at these locations, drivers entering the freeway would be subject to unsafe weaving that, in turn, results in slower travel speeds and limited mobility improvement. The safety and mobility benefits received by all travelers, including the EJ drivers accessing the freeway at the restricted access locations, offset the delay in the receipt of the travel-time saving benefit of using the express lane.

Cost of Travel Impacts

The CIA states that the operation of the Project will provide an opportunity for carpoolers to access the express lane for free and for single-occupant users to access the express lane for a fee. There is no direct economic impact, i.e., cost of travel, for those who opt to not use the express lane; however, the decision to utilize the express lane increases the cost of travel for the single-occupant user. Levying a fee may create potential inequities to low-income single-occupancy or HOV users who are less able to afford express lanes than higher-income users, regardless of minority status. The decision to use the express lane (i.e. change the cost of travel in order to improve travel time) is dependent upon users' ability and willingness to pay the toll and ability to obtain a toll tag (also known as a transponder).

Ability and Willingness to Pay Toll

The CIA states that the majority of focus group participants and intercept survey respondents expressed willingness to pay a moderate fee to use an express lane at least some of the time. When asked specifically about their ability to afford express lane usage fees, focus group participants and intercept survey respondents' responses diverged. The majority of intercept survey respondents stated that they could afford to pay a fee to utilize express lanes without having to cut expenses.

The CIA states that when asked about willingness to pay a fee to avoid congestion on freeways, 32 percent of the 129 intercept survey respondents replied that they are willing to pay money to be able to drive as a solo car in an express lane. An additional 30 percent responded that they were willing to pay at least sometimes. No respondents with incomes below 200 percent of the Federal Poverty Level were "willing" or "very willing" to pay a congestion pricing fee of $6.00. Focus group participants indicated that they would not be able to afford to use express lanes regularly, citing the unpredictability of cost and their limited budgets as primary concerns. Focus group participants across geographic locations indicated that a $2.00 fee to use an express lane is the maximum fee they could afford, and for some, even that would require cutting other expenses. Sixty-two percent of low-income intercept survey respondents indicated that they would be willing to pay a $2.00 toll to access the express lanes, and 55 percent of the respondents indicated that they would be unwilling to pay a toll of $4.00 or more to access the express lanes.

Experiences on Operational Express Lanes

The CIA states that studies have been conducted following the construction and start of operation of express lanes. The studies indicate low-income drivers pay tolls to use express lanes, but they do not pay tolls as frequently as higher-income households. This shows that low-income drivers may find it

worthwhile to pay the toll in some situations even though it may be a greater burden on their household budget than it would be for higher-income households. All income groups placed a value on the reliability and reduced travel time provided by express lanes. For lower-income groups, the value of travel time savings (VTTS) varied substantially depending on travel conditions and expected or unexpected trip urgency (Patil et al. 2011). The CIA notes that at times, calculated value of travel time savings for lower-income groups exceeded the value of ordinary trips for higher income groups, particularly due to fixed schedule constraints associated with lower-paying jobs.

Ability to Obtain a Toll Tag

In its consideration of the economic impacts of the Project on low-income populations, the CIA assesses the ability of low-income populations to obtain a toll tag. Express lane users need to have a toll tag to use the lane as a paying customer. In addition, carpoolers will need to have a switchable toll tag to access the express lane without incurring a fee. The CIA reviewed express lanes nationally and found that, as in the Bay Area, there is commonly an up-front cost to acquire a toll tag, and most systems also require a pre-paid balance from which tolls are deducted. These requirements can make it difficult for low-income persons who do not have bank accounts, debit cards, or credits cards to purchase a toll tag and maintain an account balance. It was found that in 2011, in the San Francisco Metropolitan Statistical Area (MSA), 5.9 percent of households in the MSA were unbanked, or over 108,000 households (FDIC, 2012).

The CIA states that the Bay Area Toll Authority (BATA), administrator of the FasTrak® system, has implemented a number of strategies to make it easier for all drivers to obtain a toll tag and open a FasTrak account. Customers can replenish their account with cash, check, money order or debit or credit cards. BATA's Regional Customer Service Center and numerous retail locations such as Safeway, Costco or Walgreens include the option to purchase a toll tag for $25.00 which includes $5.00 for use to pay tolls and a deposit of $20.00. Customers can check account balances, make a one-time toll payment, and pay a violation notice or an invoice at numerous Cash Payment Networks (CPN). Customers can establish anonymous accounts that do not require personal identification, and pay with cash or money order. If a motorist receives a first-time violation and sets up a new account within 30 days, the violation penalty of $25.00 is dismissed.

The CIA states that the ability to obtain a toll tag was also explored in the focus group and intercept surveys. Focus group participants stated that their preference would be to use a debit or credit card, but that many do not have one. The majority (85 percent) expressed willingness to pre-pay the deposit although for 41 percent of these participants it would involve cutting other expenses. Fifty-four percent of intercept survey respondents reported being able to maintain the minimum balance on a FasTrak toll tag without cutting expenses when paying with a debit/credit card, while 23 percent made the same statement when using the cash/check option. These results indicate that those with access to debit/credit cards have a substantially higher ability to maintain a minimum balance on a FasTrak toll tag. Focus group participants who reported that they would use cash or a check to maintain a FasTrak toll tag balance also shared concerns about having money "tied up" in an account. Few participants reported that they currently use a FasTrak toll tag to pay bridge tolls. Those that do use a toll tag

acknowledged the ease of using a FasTrak toll tag with a credit or debit card and stated that they would continue to use a FasTrak toll tag in the future to pay express lane fees. A majority of intercept survey respondents (65 percent) responded that a cash payment network - locations such as grocery, convenience, drug stores, gas stations, check cashers, and dollar stores equipped to replenish account balances - would increase the likelihood that they would obtain a FasTrak toll tag.

Benefits

The CIA states that there are transportation benefits and impacts to both the general population and EJ populations with the Project. The ability to reach a destination faster and spend less time in traffic could result in an economic benefit such as avoidance of financial penalties for being late or possibly reduction in expenditures on gasoline.

The CIA states that with the incorporation of restricted access buffers in areas with extensive merging activity, the overall operation of the freeway corridor will improve and travel speeds on the express lane and general purpose lanes will increase. Throughout the corridor, carpoolers, SOVs willing to pay the toll, transit vehicles, and other vehicles that qualify to use the lane toll-free will experience substantial increases in travel speeds in the express lane. The minority and low-income populations in the Direct Impact Area that would be using the freeway would experience these benefits for both short trips as well as longer trips where the express lane would be a very attractive alternative to the general purpose lanes if it is determined that the travel time savings benefits outweigh the cost. The CIA states that the low-income populations within the Extended Resource Area that use the I-680 corridor for their commutes will experience increased travel speeds and reduced congestion in both the express lane and general purpose lanes, and more substantial benefits with greater increases in travel speeds in the express lane.

There have been studies conducted before and after implementation of express or HOT lanes that indicated that there are perceived benefits from express lanes across all populations, including low-income and minority populations (Appendix C in the CIA). For the studies that reported statistics on participant preferences by income groups, the results indicated that while support for express lanes by people of all income groups was not high, more low-income persons were supportive of planned express lane highway improvements than were against, and there was greater support among low-income groups than non-low-income groups.

4.2.4 Conclusion

The CIA concludes that the Project results in a number of benefits to low-income drivers using the I-680 corridor, as well as a potential to affect transportation usage and potential economic impacts. However, there is no evidence to suggest that the express lanes will in any way substantially degrade existing travel choices. Since the Project will provide a choice for solo drivers, and carpoolers to access them for free, with no changes to the free general purpose lanes, low-income drivers who choose to use the facility will perceive benefits that outweigh the cost while low-income drivers who choose to not use the facility will experience no change. The Project will not result in disproportionate adverse transportation

impacts or in disproportionately high or adverse economic impacts to minority and low-income populations.

Appendix A: Measures of Effectiveness from the I-680 North TOAR

TABLE 3-11
EXISTING NORTHBOUND I-680 AM STUDY PERIOD NETWORK MEASURES OF EFFECTIVENESS

Measure	HOV	SOV (Excludes Trucks)
All Origin-Destination Pairs		
Volume Served	3,500	32,800
Vehicle Miles of Travel (VMT)	17,200	168,400
Vehicle Hours of Delay (VHD) in hours	5	60
Travel Through the Corridor		
Average Travel Time (minutes)	9.2	9.2
Average Travel Speed (mph)	65	65
Maximum Individual Vehicle Delay (minutes)	0.0	0.0

Notes:
1. All origin-destination pairs consider all on- and off-ramps in the study network
2. Travel through the corridor includes only those vehicles that travel from one end of the corridor to the end of the corridor
3. Delay is calculated relative to 65 mph
Source: Fehr & Peers, 2014.

TABLE 3-12
EXISTING NORTHBOUND I-680 PM STUDY PERIOD NETWORK MEASURES OF EFFECTIVENESS

Measure	HOV	SOV (Excludes Trucks)
All Origin-Destination Pairs		
Volume Served	14,500	66,600
Vehicle Miles of Travel (VMT)	68,200	314,000
Vehicle Hours of Delay (VHD) in hours	600	3,000
Travel Through the Corridor		
Average Travel Time (minutes)	10.6	11.9
Average Travel Speed (mph)	58	57
Maximum Individual Vehicle Delay (minutes)	0.3	1.6

Notes:
1. All origin-destination pairs consider all on- and off-ramps in the study network
2. Travel through the corridor includes only those vehicles that travel from one end of the corridor to the end of the corridor
3. Delay is calculated relative to 65 mph
Source: Fehr & Peers, 2014.

TABLE 3-13
EXISTING SOUTHBOUND I-680 AM STUDY PERIOD NETWORK MEASURES OF EFFECTIVENESS

Measure	HOV	SOV (Excludes Trucks)
All Origin-Destination Pairs		
Volume Served	10,300	78,400
Vehicle Miles of Travel (VMT)	83,100	626,900
Vehicle Hours of Delay (VHD) in hours	320	5,100
Travel Through the Corridor		
Average Travel Time (minutes)	29.1	36.6
Average Travel Speed (mph)	58	46
Maximum Individual Vehicle Delay (minutes)	8.5	23.0

Notes:
1. All origin-destination pairs consider all on- and off-ramps in the study network
2. Travel through the corridor includes only those vehicles that travel from one end of the corridor to the end of the corridor
3. Delay is calculated relative to 65 mph
Source: Fehr & Peers, 2014.

TABLE 3-14
EXISTING SOUTHBOUND I-680 PM STUDY PERIOD NETWORK MEASURES OF EFFECTIVENESS

Measure	HOV	SOV (Excludes Trucks)
All Origin-Destination Pairs		
Volume Served	12,200	88,100
Vehicle Miles of Travel (VMT)	81,500	589,500
Vehicle Hours of Delay (VHD) in hours	130	1,500
Travel Through the Corridor		
Average Travel Time (minutes)	24.9	25.9
Average Travel Speed (mph)	65	65
Maximum Individual Vehicle Delay (minutes)	3.7	1.9

Notes:
1. All origin-destination pairs consider all on- and off-ramps in the study network
2. Travel through the corridor includes only those vehicles that travel from one end of the corridor to the end of the corridor
3. Delay is calculated relative to 65 mph
Source: Fehr & Peers, 2014.

TABLE 5-1
2020 NORTHBOUND I-680 AM STUDY PERIOD NETWORK MEASURES OF EFFECTIVENESS

Measure	2020 No Build			2020 Build		
	HOV	TOLL[1]	SOV	HOV	TOLL[1]	SOV
All Origin-Destination Pairs[2]						
Volume Served	4,200	0	34,500	4,200	0	34,500
Vehicle Miles of Travel (VMT)	20,600	0	177,800	20,600	0	177,800
Vehicle Hours of Delay (VHD) in hours [3]	10	0	80	10	0	80
Travel Through the Corridor[4]						
Average Travel Time (minutes)[5]	9	--	9	9	--	9
Average Travel Speed (mph)[6]	65	--	64	65	--	64
Maximum Individual Vehicle Delay (minutes) [7]	0.2	--	0.2	0.2	--	0.2

Notes
1. Assumes zero TOLL drivers because no incentive for TOLL drivers to use the Express Lane.
2. All origin-destination pairs consider all on- and off-ramps in the study network
3. Vehicles hours of Delay (VHD) is a measure of the total delay incurred by all vehicles using the study corridor during the study period due to congestion; delay is calculated relative to a baseline of 65 mph, the posted speed limit on I-680.
4. Northbound average travel time and speed for each driver type is measured between the Ygnacio Valley Road and the Marina Vista Avenue interchanges (approximately 10 miles).
5. Free-flow travel time, based on 65 mph, approximately 9 minutes.
6. Average speed measures the speed of a vehicle traveling through the entire network, from one end of the study corridor to the other end of the corridor.
7. Delay is calculated relative to 65 mph.
Source: Fehr & Peers, 2015

TABLE 5-2
2020 NORTHBOUND I-680 PM STUDY PERIOD NETWORK MEASURES OF EFFECTIVENESS

Measure	2020 No Build			2020 Build		
	HOV	TOLL[1]	SOV	HOV	TOLL[1]	SOV
All Origin-Destination Pairs[2]						
Volume Served	15,600	0	65,900	15,600	0	65,900
Vehicle Miles of Travel (VMT)	73,200	0	304,000	73,200	0	304,000
Vehicle Hours of Delay (VHD) in hours [3]	1,200	0	5,100	1,200	0	5,100
Travel Through the Corridor[4]						
Average Travel Time (minutes)[5]	12	--	13	12	--	13
Average Travel Speed (mph)[6]	56	--	54	56	--	54
Maximum Individual Vehicle Delay (minutes) [7]	4.6	--	6.1	4.6	--	6.1

Notes
1. Assumes zero TOLL drivers because no incentive for TOLL drivers to use the Express Lane.
2. All origin-destination pairs consider all on- and off-ramps in the study network
3. Vehicles hours of Delay (VHD) is a measure of the total delay incurred by all vehicles using the study corridor during the study period due to congestion; delay is calculated relative to a baseline of 65 mph, the posted speed limit on I-680.
4. Northbound average travel time and speed for each driver type is measured between the Ygnacio Valley Road and the Marina Vista Avenue interchanges (approximately 10 miles).
5. Free-flow travel time, based on 65 mph, approximately 9 minutes.
6. Average speed measures the speed of a vehicle traveling through the entire network, from one end of the study corridor to the other end of the corridor.
7. Delay is calculated relative to 65 mph.
Source: Fehr & Peers, 2015

TABLE 5-4
2020 SOUTHBOUND I-680 AM STUDY PERIOD NETWORK MEASURES OF EFFECTIVENESS

Measure	2020 No Build			2020 Build		
	HOV	TOLL	SOV	HOV	TOLL	SOV
All Origin-Destination Pairs[1]						
Volume Served	10,700	2,900	78,900	10,000	3,100	78,200
Vehicle Miles of Travel (VMT)	86,700	45,300	598,400	80,900	49,400	591,800
Vehicle Hours of Delay (VHD) in hours	190	470	5,100	370	70	4,400
Travel Through the Corridor[2]						
Average Travel Time (minutes)[3]	26	38	38	26	26	34
Average Travel Speed (mph)	61	54	54	62	62	57
Maximum Individual Vehicle Delay (minutes)[4]	1.4	25.2	25.2	1.5	1.5	15.3

Notes
1. All origin-destination pairs consider all on- and off-ramps in the study network
2. Vehicles hours of Delay (VHD) is a measure of the total delay incurred by all vehicles using the study corridor during the study period due to congestion; delay is calculated relative to a baseline of 65 mph, the posted speed limit on I-680.
3. Southbound average travel time and speed for each driver type is measured between the Marina Vista Avenue and the Stoneridge Drive interchanges (approximately 27 miles).
4. Free-flow travel time, based on 65 mph, approximately 25 minutes.
5. Average speed measures the speed of a vehicle traveling through the entire network, from one end of the study corridor to the other end of the corridor.
6. Delay is calculated relative to 65 mph.
Source: Fehr & Peers, 2015

TABLE 5-5
2020 SOUTHBOUND I-680 PM STUDY PERIOD NETWORK MEASURES OF EFFECTIVENESS

Measure	2020 No Build			2020 Build		
	HOV	TOLL[3]	SOV	HOV	TOLL[3]	SOV
All Origin-Destination Pairs[1]						
Volume Served	12,800	1,400	90,800	12,900	1,500	91,700
Vehicle Miles of Travel (VMT)	85,900	23,400	594,400	86,200	24,200	601,500
Vehicle Hours of Delay (VHD) in hours [2]	130	260	3,400	130	30	2,100
Travel Through the Corridor[3]						
Average Travel Time (minutes)[4]	24	33	33	24	24	29
Average Travel Speed (mph)[5]	65	60	60	65	65	63
Maximum Individual Vehicle Delay (minutes)[6]	0.6	16.6	16.6	1.1	1.1	7.8

Notes
1. All origin-destination pairs consider all on- and off-ramps in the study network
2. Vehicles hours of Delay (VHD) is a measure of the total delay incurred by all vehicles using the study corridor during the study period due to congestion; delay is calculated relative to a baseline of 65 mph, the posted speed limit on I-680.
3. Southbound average travel time and speed for each driver type is measured between the Marina Vista Avenue and the Stoneridge Drive interchanges (approximately 27 miles).
4. Free-flow travel time based on 65 mph, approximately 25 minutes.
5. Average speed measures the speed of a vehicle traveling through the entire network, from one end of the study corridor to the other end of the corridor.
6. Delay is calculated relative to 65 mph.
Source: Fehr & Peers, 2015

TABLE 6-1
2040 NORTHBOUND I-680 AM STUDY PERIOD NETWORK MEASURES OF EFFECTIVENESS

Measure	2040 No Build			2040 Build		
	HOV	TOLL[1]	SOV	HOV	TOLL[1]	SOV
All Origin-Destination Pairs[2]						
Volume Served	4,700	--	38,000	4,700	--	38,000
Vehicle Miles of Travel (VMT)	22,900	--	193,200	22,900	--	193,200
Vehicle Hours of Delay (VHD) in hours [3]	13	--	127	13	--	127
Travel Through the Corridor[4]						
Average Travel Time (minutes)[5]	9	--	9	9	--	9
Average Travel Speed (mph)[6]	65	--	64	65	--	64
Maximum Individual Vehicle Delay (minutes)[7]	0.5	--	0.5	0.5	--	0.5

Notes
1. Assumes zero TOLL drivers because no incentive for TOLL drivers to use the Express Lane.
2. All origin-destination pairs consider all on- and off-ramps in the study network
3. Vehicles hours of Delay (VHD) is a measure of the total delay incurred by all vehicles using the study corridor during the study period due to congestion; delay is calculated relative to a baseline of 65 mph, the posted speed limit on I-680.
4. Northbound average travel time and speed for each driver type is measured between the Ygnacio Valley Road and the Marina Vista Avenue interchanges (approximately 10 miles).
5. Free-flow travel time, based on 65 mph, approximately 9 minutes.
6. Average speed measures the speed of a vehicle traveling through the entire network, from one end of the study corridor to the other end of the corridor.
7. Delay is calculated relative to 65 mph.
Source: Fehr & Peers, 2015

TABLE 6-2
2040 NORTHBOUND I-680 PM STUDY PERIOD NETWORK MEASURES OF EFFECTIVENESS

Measure	2040 No Build			2040 Build		
	HOV	TOLL	SOV	HOV	TOLL	SOV
All Origin-Destination Pairs[1]						
Volume Served	16,600	690	66,500	16,600	730	66,600
Vehicle Miles of Travel (VMT)	77,200	8,000	275,800	90,77,300	8,000	276,000
Vehicle Hours of Delay (VHD) in hours [2]	2,400	150	7,600	2,400	140	7,500
Travel Through the Corridor[3]						
Average Travel Time (minutes)[4]	13	15	15	13	13	15
Average Travel Speed (mph)[5]	55	53	53	55	55	53
Maximum Individual Vehicle Delay (minutes)[6]	6.3	8.9	8.9	6.3	6.3	8.3

Notes
1. All origin-destination pairs consider all on- and off-ramps in the study network
2. Vehicles hours of Delay (VHD) is a measure of the total delay incurred by all vehicles using the study corridor during the study period due to congestion; delay is calculated relative to a baseline of 65 mph, the posted speed limit on I-680.
3. Northbound average travel time and speed for each driver type is measured between the Ygnacio Valley Road and the Marina Vista Avenue interchanges (approximately 10 miles).
4. Free-flow travel time, based on 65 mph, approximately 9 minutes.
5. Average speed measures the speed of a vehicle traveling through the entire network, from one end of the study corridor to the other end of the corridor.
6. Delay is calculated relative to 65 mph.
Source: Fehr & Peers, 2015

TABLE 6-4
2040 SOUTHBOUND I-680 AM STUDY PERIOD NETWORK MEASURES OF EFFECTIVENESS

Measure	2040 No Build			2040 Build		
	HOV	TOLL	SOV	HOV	TOLL	SOV
All Origin-Destination Pairs[1]						
Volume Served	11,600	2,300	80,800	11,700	2,900	81,300
Vehicle Miles of Travel (VMT)	93,700	49,400	611,900	94,900	57,600	615,900
Vehicle Hours of Delay (VHD) in hours [2]	700	1,000	10,600	800	130	7,700
Travel Through the Corridor[3]						
Average Travel Time (minutes)[4]	29	54	54	27	27	43
Average Travel Speed (mph)[5]	58	47	47	61	61	51
Maximum Individual Vehicle Delay (minutes) [6]	6.5	66.6	66.6	3.1	3.1	33.4

Notes
1. All origin-destination pairs consider all on- and off-ramps in the study network
2. Vehicles hours of Delay (VHD) is a measure of the total delay incurred by all vehicles using the study corridor during the study period due to congestion; delay is calculated relative to a baseline of 65 mph, the posted speed limit on I-680.
3. Southbound average travel time and speed for each driver type is measured between the Marina Vista Avenue and the Stoneridge Drive interchanges (approximately 27 miles).
4. Free-flow travel time, based on 65 mph, approximately 25 minutes.
5. Average speed measures the speed of a vehicle traveling through the entire network, from one end of the study corridor to the other end of the corridor.
6. Delay is calculated relative to 65 mph
Source: Fehr & Peers, 2015

TABLE 6-5
2040 SOUTHBOUND I-680 PM STUDY PERIOD NETWORK MEASURES OF EFFECTIVENESS

Measure	2040 No Build			2040 Build		
	HOV	TOLL	SOV	HOV	TOLL	SOV
All Origin-Destination Pairs[1]						
Volume Served	13,276	1,021	93,522	13,429	1,400	95,922
Vehicle Miles of Travel (VMT)	88,000	17,800	596,500	89,600	23,600	618,800
Vehicle Hours of Delay (VHD) in hours [2]	830	870	20,100	900	200	18,800
Travel Through the Corridor[3]						
Average Travel Time (minutes)[4]	29.2	88.4	88.4	29.3	29.3	79.1
Average Travel Speed (mph)[5]	60	40	40	60	60	40
Maximum Individual Vehicle Delay (minutes) [6]	5.5	127.8	127.8	6.0	6.0	103.6

Notes
1. All origin-destination pairs consider all on- and off-ramps in the study network
2. Vehicles hours of Delay (VHD) is a measure of the total delay incurred by all vehicles using the study corridor during the study period due to congestion; delay is calculated relative to a baseline of 65 mph, the posted speed limit on I-680.
3. Southbound average travel time and speed for each driver type is measured between the Marina Vista Avenue and the Stoneridge Drive interchanges (approximately 27 miles).
4. Free-flow travel time, based on 65 mph, approximately 25 minutes.
5. Average speed measures the speed of a vehicle traveling through the entire network, from one end of the study corridor to the other end of the corridor.
6. Delay is calculated relative to 65 mph.
Source: Fehr & Peers, 2015