Final Report

I-680 HOV/Express Bus Access Study

TBG100509114235BAO

Prepared for

TRANSPAC
Contra Costa Transportation Authority
Central Contra Costa Transit Authority

Prepared by

CH2MHILL

June 2010

Final Report

I-680 HOV/Express Bus Access Study

Prepared for

TRANSPAC
Contra Costa Transportation Authority
Central Contra Costa Transit Authority

June 2010

CH2MHILL

and

DKS Associates
TRANSPORTATION SOLUTIONS

Contents

Tables

Figures

Appendices

Acronyms and Abbreviations

ACE	Altamont Commuter Express
BART	Bay Area Rapid Transit
CCTA	Contra Costa Transportation Authority
County Connection	Central Contra Costa Transit Authority
EB	eastbound
FAST	Fairfield & Suisun Transit
HOV	high occupancy vehicle
LAVTA	Livermore Amador Valley Transit Authority
LOS	Level of Service
MTC	Metropolitan Transportation Commission
MTSO	Multi-modal Transportation Service Objective
NB	northbound
PAC	Policy Advisory Committee
PDS	Project Development Support
PSR	Project Study Report
RM 2	Regional Measure 2
SB	southbound
SOV	single occupancy vehicle
SR	State Route
SRTP	Short Range Transit Plan
SWAT	Southwest Area Transportation Committee
TAC	Technical Advisory Committee
TOD	Transit-Oriented Development
TSO	Traffic Safety Objective
TSP	transit signal priority
TVTC	Tri-Valley Transportation Council

TRANSPAC	Transportation Partnership and Cooperation, the Regional Transportation Planning Committee for central Contra Costa County
WB	westbound

Executive Summary

A primary goal of the I-680 HOV/Express Bus Study has been to identify the best investment option(s) for HOV and express bus operations in the Contra Costa I-680 corridor, including access to the Pleasant Hill and Walnut Creek BART Stations, as defined by Regional Measure 2 (RM 2).

The Study recommendation is that **Option 1. Southbound I-680 HOV Lane Gap Closure Project** receive the available RM 2 funding. This conclusion was reached after evaluating five options. Two of these options were identified as Regional Measure 2 Investment Options and three Other Arterial Options were also examined. A brief description of each of these options and the results of the evaluation are provided below.

Description of Options Evaluated

Regional Measure 2 Investment Options

Two options were evaluated for the purpose of selecting one option to be recommended for use of available Regional Measure 2 funds. Both of these options are capital improvements on I-680 that serve express buses and HOVs.

Option 1: Southbound I-680 HOV Lane Gap Closure Project

This project is included in the Regional Transportation Plan, and proposes to close the existing gap in the southbound I-680 HOV lane from 0.2 mile north of the Geary Road interchange, through the SR 24 interchange and to the Livorna Road interchange. The alternative examined would widen the existing roadway to add a median HOV lane from 0.2 mile north of Livorna Road to 500 feet north of South Main Street Undercrossing, and re-stripe the existing roadway from South Main Street to 0.4 mile north of North Main Street to continue the HOV lane to just north of Geary Road, without any right-of-way acquisitions. This alternative would require reducing the widths of the left shoulder as well as some of the inside lanes. The project would include reconstructing retaining and sound walls, widening bridges, restriping the existing roadway, modifying existing fiber optical cable and traffic operations systems, installing ramp metering systems, and upgrading median barrier to standard.

Option 2: I-680 HOV Direct Connector Ramps to Walnut Creek BART

Multiple alternatives for HOV direct connector ramps to both the Walnut Creek and Pleasant Hill BART Stations were developed in this study. Through a screening process, the most feasible alternative for this study was identified.

The selected option for HOV direct connector ramps would serve both express buses and HOVs coming from and going to the north of the Walnut Creek BART Station. Express buses and HOVs traveling south on I-680 would exit the HOV lane via the new ramp that descends to an at-grade intersection that would be an L-shaped two-way stop-controlled intersection. The vehicles would turn left and cross under I-680 northbound lanes and arrive at the perimeter road at the BART station, via a freeway undercrossing structure. The

express buses and HOVs accessing northbound I-680 would also use the structure under the I-680 northbound lanes and enter the freeway on the left-side via the northbound direct on-ramp. This option would not significantly impact the planned transit-oriented development for the Walnut Creek BART Station.

The associated work would include widening of I-680 to create room in the median for the HOV direct access ramps; construction of a "U" trench for the HOV direct access ramps connecting to the new access road; widening of the three existing undercrossing structures and removal of a portion of an undercrossing structure at Ygnacio Valley Road; realignment of Ygnacio Valley Road on-ramps to southbound I-680 and westbound SR 24; widening of the undercrossing structure at Parkside Drive; relocation of the intersection of Parkside Drive and San Juan Avenue; and relocation of Buena Vista Avenue to the west as a result of the freeway widening.

In the development and evaluation of the HOV Direct Connector Ramp option, it was assumed that two future planned HOV lane projects on I-680 would be in place as part of the future baseline. Essentially, these projects would provide the baseline HOV facility on the freeway mainline to which the HOV ramp would be able to connect. The two projects are the **Southbound I-680 HOV Lane Gap Closure Project**, which is Option 1 described above, and the **Northbound I-680 HOV Lane Project**, which adds an HOV lane on I-680 in the northbound direction from the North Main Street Overcrossing north to connect to an existing HOV lane that begins just north of the I-680/ SR 242 interchange.

Other Arterial Improvements

For this study, a variety of "other arterial freeway" improvement options were developed that focus primarily on the roadway system in the vicinity of the Walnut Creek and Pleasant Hill BART stations. These options are not eligible for RM 2 funding.

Option 3: Buskirk Roadway Improvements

This option seeks to improve the roadway in a manner consistent with current City of Pleasant Hill plans, through geometric modifications, roadway realignment, and intersection modifications, including transit signal priority (TSP). Specific improvements include abandoning the existing S-curve section of Buskirk Avenue between Elmira Lane and Hookston Road; widening the existing two-lane and three-lane roadway segments of Buskirk Avenue, Elmira Lane and Hookston Road to a four-lane segment; removal of the existing all-way-stop-control intersection at Elmira Lane and Hookston Road; construction of a smooth curve between Buskirk Avenue and the north end of Elmira Lane; installation of a new traffic signal at the intersection of Elmira Lane and Hookston Road; and installation of transit signal priority (TSP) at all signalized intersections on Buskirk Avenue from Monument Boulevard to Treat Boulevard.

Option 4: Express Bus Consolidation at Walnut Creek BART Station

Currently, a number of long distance express bus routes traveling to and from the north terminate at the Pleasant Hill BART Station, while those traveling to and from the south terminate at the Walnut Creek BART station. The proposed routing in this option would consolidate all long distance express bus service at the Walnut Creek BART station. The express buses traveling from the north would be rerouted to exit I-680 freeway via N. Main St exit and continue on N. Main St toward Walnut Creek BART Station. In the opposite

direction, express buses departing from Walnut Creek BART Station would travel along N Main St and enter I-680 northbound through the Lawrence Way entry. Transit signal priority would also be implemented at three intersections between I-680 and Walnut Creek BART to improve transit travel times.

By consolidating the long distance express bus service at Walnut Creek BART; a regional bus hub would be created that brings the north-oriented bus service (such as those from Solano County) together with the south-oriented bus service (such as those serving San Ramon / Bishop Ranch), allowing better transfers between these services. Ability to transfer to a BART station would be preserved for all express bus lines. However, those coming from the north may find fewer seats available on the BART trains at the Walnut Creek BART Station, as compared to the Pleasant Hill BART Station.

Option 5: Transit Signal Priority / Queue Jump Lanes

For this option, transit signal priority (TSP) and/or queue jump lanes would be installed on the intersections between I-680 and the Pleasant Hill and Walnut Creek BART stations. These improvements would be to the surface streets that express buses use to access the BART stations and would help lower travel times and increase service reliability. Fourteen intersections would be affected by Alternative 5. Of these, three would include implementation of TSP and queue jump lanes.

Prioritization of Options

Each of the five options was evaluated based on a wide range of evaluation criteria that were developed in coordination with the Study TAC and PAC. The criteria, evaluation scores and results of the structured decision-making process used are summarized below.

Evaluation Criteria

The evaluation criteria are both quantitative and qualitative, and are briefly described below.

- **HOV/Transit Connectivity** (qualitative) – extent to which the option would increase access to, and connectivity with, existing and future HOV/transit facilities.
- **Transit Operations** (qualitative) – extent to which the option would ease transfers between routes and modes. Also includes an assessment as to whether the option would result in more efficient operations for the transit operators.
- **Traffic Operations** (quantitative) – potential impact to roadway operations. Performance measures assessed for the Regional Measures 2 Investment Options, which are freeway-based strategies, included hours of delay, HOV/Bus travel time, mode shift, and freeway operations (weaving). Performance measures assessed for the arterial-based strategies included HOV/Bus travel time and intersection delay.
- **Environmental Impacts** (qualitative) – potential impact on the natural and built environment. The assessment was based on existing information and a "windshield survey" of the corridor; no field studies or original analyses was performed. This assessment considered several factors including potential impacts to air quality, noise, natural resources, aesthetics and right-of-way.

- **Right-of-Way Impacts** (quantitative) – number of parcels potentially impacted. For this level of evaluation, full versus partial takes were not differentiated.
- **Capital Cost** (quantitative) - order-of-magnitude capital cost estimates in current (2009) dollars. Right-of-way costs are not included in this cost estimate.

The evaluation was conducted both with and without the consideration of the estimated capital costs for each option.

A structured decision-making process was used to evaluate the options identified. CH2M HILL used Criterium DecisionPlus, a commercially available software tool to conduct the decision analysis. The evaluation criteria were weighted to reflect the relative importance of each criterion. The weighting of the evaluation criteria was developed by the study TAC and PAC and are provided in **TableES-1**.

TABLE ES-1
Evaluation Criteria and Weighting

Evaluation Criteria	Weighting
HOV/Transit Connectivity	25
Transit Operations	20
Traffic Operations	10
Environmental Impacts	15
Right-of-Way Impacts	10
Capital Cost	20
Total Criteria Weights	100

Evaluation Scores

Based on the evaluation conducted in this study, the assessment of each of the evaluation criteria were converted to a 1-to-5 scale for input into the decision analysis tool. A score of "5" indicates the most beneficial impact, and a "1" indicates the least beneficial impact. The assignment of scores for each option and criteria (except cost) is provided in **Table ES-2.** Capital cost estimates, also shown in **Table ES-2**, were input directly, and did not need to be converted to a scale.

TABLE ES-2
Evaluation Scores by Criteria and Option

Evaluation Criteria	Options				
	1. SB I-680 HOV Lane Gap Closure	**2. I-680 HOV Direct Ramps**	**3. Buskirk Roadway Improvements**	**4. Express Bus Consolidation**	**5. Traffic Signal Priority/ Queue Jump Lanes**
HOV/Transit Connectivity	5	4	2	3	3
Transit Operations	5	4	3	3	2
Traffic Operations	5	3	2	1	1
Environmental Impacts	5	4	2	3	3
Right-of-Way Impacts	5	1	3	5	5
Capital Cost (million $)	45.3	104.3	7.1	0.08	0.24

Note: A score of "5" indicates the most beneficial impact, and a "1" indicates the least beneficial impact.

Results of Prioritization

All five of the identified options were assessed using the structured decision-making process. A score was developed based on the evaluation performed for each of the criteria identified. This score in only applicable for the comparison described here. Scores do not have an intrinsic value and cannot be compared across different sets of evaluations. The relative scores depicted in **Figure ES-1** are based on all of the criteria, and the relative scores depicted in **Figure ES-2** do not include cost as a criterion.

With cost included as a criterion, **Option 1 – Southbound I-680 HOV Lane Gap Closure** Project scores the highest. When cost is removed as a criterion, Option 1 continues to score the highest.

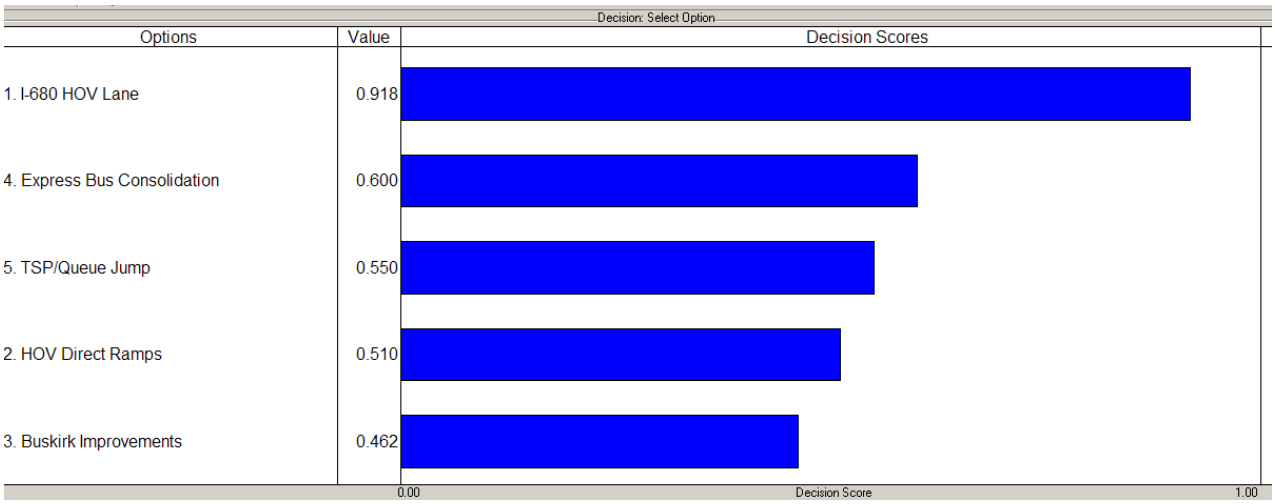


FIGURE ES-1
Prioritization of All Options with Cost

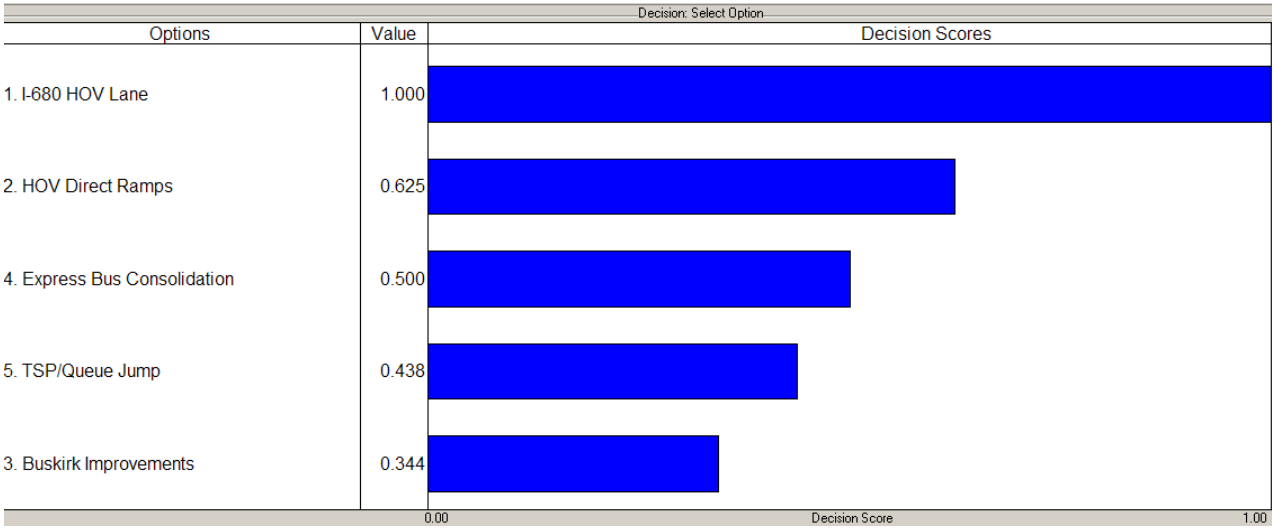


FIGURE ES-2
Prioritization of All Options without Cost

1.0 Introduction

1.1 Study Background

The I-680 HOV/Express Bus Study is a multi-agency effort funded through Regional Measure 2 (RM 2). RM 2, passed by the voters in March 2004, provided for a $1 increase in bridge tolls on California Department of Transportation (Caltrans)-operated bridges. The bridge toll monies are to go towards funding the completion of the Eastern Span of the Bay Bridge and funding of transportation improvements related to travel in the bridge corridors.

RM 2 set aside $15 million for high occupancy vehicle (HOV) improvements on I-680 in central Contra Costa. The Central Contra Costa Transit Authority (County Connection) was designated as the lead agency for the study to determine the best investment option for the RM 2 funds. County Connection requested, and TRANSPAC (Transportation Partnership and Cooperation, the Regional Transportation Planning Committee for central Contra Costa County) agreed, to be the lead agency for conducting this study. This study is required to provide the evaluation and support the decision-making process as to whether these RM 2 funds should be expended to fund an HOV Direct Ramp from I-680 to either the Pleasant Hill or Walnut Creek Bay Area Rapid Transit (BART) Stations, or to fund the I-680 Southbound HOV Lane Gap Closure project. With the completion of this study, the Contra Costa Transportation Authority (CCTA) will adopt a preferred alternative for RM 2 funding.

Even though no specific funding source is identified, RM 2 also encourages the examination of options and recommendations for providing express bus service on the I-680 HOV lane south of the Benicia-Martinez Bridge. In this study, options are investigated to determine whether they would improve operations for express buses and HOVs in the I-680 corridor. Also examined is whether these options create more efficient linkages for express buses and HOVs between I-680 and the Pleasant Hill and Walnut Creek BART Stations.

The study area is illustrated in **Figure 1-1**.

1.2 Types of Options Evaluated

Throughout this report, reference will be made to two categories of options. The first category, "RM 2 Investment Options," includes those options that are eligible for RM 2 funding as specified in the legislation. Only the I-680 Southbound HOV Lane Gap Closure project and HOV Direct Ramp options can be included in this category.

The second category is referred to as "Other Arterial and Freeway Improvements." This is a broad category that covers options that would potentially improve express bus and HOV operations in the I-680 corridor, but are not included in the RM 2 Investment Options. These options include improvements to streets connecting the I-680 freeway to the Pleasant Hill and Walnut Creek BART Stations. Alternatives could include improvements to the

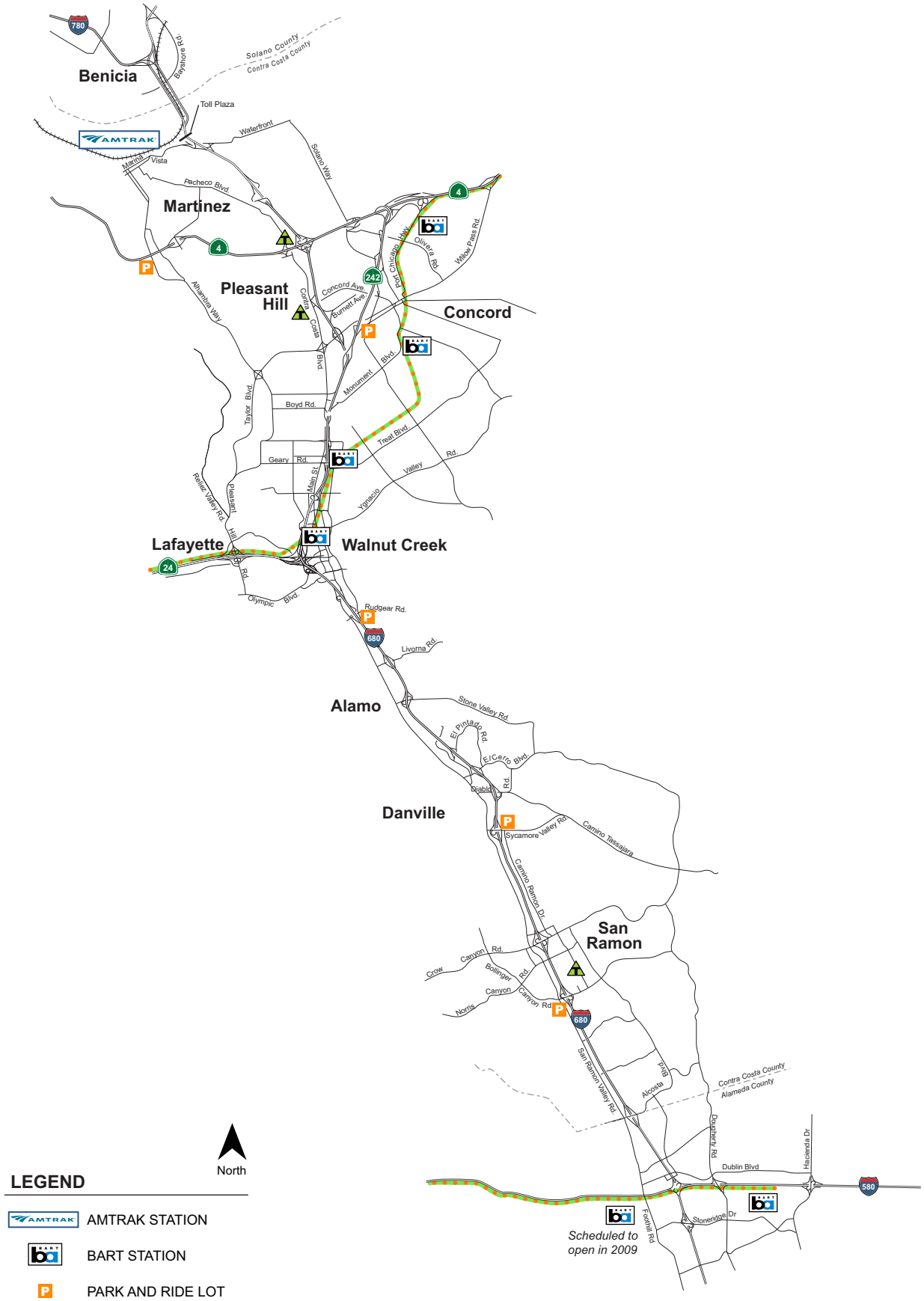


FIGURE 1-1
Study Area
I-680 HOV/Express Bus Access Study

freeway or arterials. However, any direct HOV connections/ramps are included in the RM 2 Investment Options. There is no identified funding source for the options in the Other Arterial and Freeway Improvements category.

1.3 Related Issue Papers

Three issue papers have been prepared for this study that are based on related analyses performed, but do not directly address the requirements of the RM 2 legislation. These issue papers are provided as appendices to this report and the topics of each are provided below.

Appendix C: Consistency in HOV Hours of Operation and Occupancy Requirements for I-680 and the Benicia-Martinez Bridge

Appendix D: I-680 Southbound HOV Lane Extension

Appendix E: Bus Rapid Transit – An Overview of Potential Applicability and Implementation Issues

1.4 Advisory Committee Representation

The I-680 HOV/Express Bus Study was guided by a Policy Advisory Committee (PAC) that consisted of two representatives and one alternative appointed by each of the following agencies: TRANSPAC, County Connection, and CCTA.

Technical input and review was provided by a Technical Advisory Committee (TAC). The study TAC included the agencies represented on the TRANSPAC TAC (member jurisdictions, 511 Contra Costa, BART, Caltrans, CCTA, Contra Costa County, and County Connection. The study TAC also included other transit agencies that serve Central Contra Costa: City of Benicia/Transit, City of Fairfield/Transit, and Livermore/Wheels. Other interested agencies represented on the TAC included the Metropolitan Transportation Commission (MTC), Southwest Area Transportation Committee (SWAT), and the Solano Transportation Authority.

2.0 Background Information

Recently completed or current studies located within the study area, as well as Short Range Transit Plans (SRTPs), are presented in **Table 2-1**. The table also includes an assessment of the relevance of the available information from each source to the present study.

The existing studies reviewed include:

- Site-specific studies, such as the Walnut Creek BART Comprehensive Station Plan;
- Corridor-wide studies, such as the I-680 Investment Options Analysis;
- Area-wide or County-wide studies, such as the Contra Costa Express Bus Study; and
- Regional studies, such as the MTC Transit Connectivity Study.

These studies provide insights into the types of improvement strategies, services, and policies that have been considered for the study area. The studies also provide information on traffic conditions, travel patterns, transit characteristics, and roadway infrastructure.

The transit plans reviewed include those of County Connection, Vallejo Transit, Livermore Amador Valley Transit Authority (LAVTA), and Fairfield & Suisun Transit (FAST). These transit plans provide information regarding the planned and programmed near term, and some long term, transit facility improvements.

TABLE 2-1
Relevant Studies

Study Name	Study Area	Study Description	Lead Agency	Status	Issues/Comments	Relevance to I-680 HOV/Express Bus Study
Contra Costa Countywide Comprehensive Transportation Plan	Contra Costa County	Policy and planning document including a comprehensive transportation project list	CCTA	Updated May 2004	Updated plan will combine action plans; EIR also to be prepared.	Planned improvements throughout Contra Costa County. Update will consolidate recommendations from individual Action Plans.
I-680 Investment Options Study	I-680 from SR 24 to I-580	Examined alternative major capital investments for consideration within Measure C reauthorization	CCTA	Study completed May 2003	Identified HOV/transit improvements as preferred option over various rail options. Recommended improvements included: express bus service enhancements, HOV lane gap closure to the north, HOV lane extension to the south, HOV ramps at Norris Canyon and Sycamore Valley.	Identifies set of HOV/transit improvements for this segment. Provides limited data: 2000 counts, census info on travel patterns; 2020 forecasts; transit service info.
Contra Costa Ramp Metering Study and I-680 Aux Lanes Project Study Report (PSR)	I-680 from Benicia-Martinez Bridge to Alameda County line	Examined potential impacts of ramp metering and auxiliary lanes	CCTA	Study completed June 2003	Study provides recommendations related to implementation of ramp metering and auxiliary lanes; PSR supports implementation of auxiliary lanes that have been constructed.	Provided FREQ model covering all of I-680 that was used and updated as part of the I-680 North Freeway Performance Initiative Corridor Study.
SR 24 Transit Capacity Study	SR 24 from I-680 to Caldecott	Identify potential transit capacity enhancing improvements	CCTA/ County Connection	Study completed January 2006	Identified BART enhancements as preferred alternative over express bus and HOV lane options. Analysis focused on westbound AM peak only.	Provided CORSIM model of SR 24; data from Caldecott EIR (2000 counts, 2032 forecasts); transit ridership data and forecasts; Census travel patterns; limited travel time data; transit service information.
I-680 North Freeway Performance Initiative Corridor Study	I-680 between I-80 and Alameda County Line	Studying existing and future freeway operations and proposing corridor improvements	MTC	Study underway	Includes assessment of various HOV lane improvements in the study area.	Provides FREQ model of the study area, TASAS data, travel time data, freeway and ramp counts, bottleneck locations along I-680, existing transit routes along I-680, and proposed corridor improvements.

TABLE 2-1
Relevant Studies

Study Name	Study Area	Study Description	Lead Agency	Status	Issues/Comments	Relevance to I-680 HOV/Express Bus Study
I-680/Norris Canyon HOV Direct Ramp PSR	I-680 from Crow Canyon to Bollinger Canyon	Examining potential HOV-only ramps at Norris Canyon over-crossing	CCTA	Study underway	--	Preliminary layout and cost estimate for HOV direct ramps. Forecasts of HOV usage of the direct ramps.
I-680 Northbound HOV Lane Extension PSR	I-680 from North Main to SR 242	Examining extension to NB HOV lanes to begin near North Main to current start point just north of SR 242	Caltrans	Final PSR completed March 2007	--	Preliminary layout and cost estimate for NB HOV Lane in study area. Forecasts of traffic and HOV usage.
I-680 Southbound HOV Lane Gap Closure PSR / PDS	I-680 from North Main to Livorna	Examining new HOV lane to fill gap in existing system within Walnut Creek through the SR 24 interchange.	Caltrans	Draft PSR March 2009	--	Preliminary layout and cost estimate for SB HOV Lane Gap Closures in study area. Forecasts of traffic and HOV usage.
Contra Costa Express Bus Study	Contra Costa County	Examining concepts to provide express buses inside and between regions of Contra Costa County.	CCTA	Study Completed December 2001	Some new services initiated. A study update is being considered.	Recommendations included express bus or arterial freeway strategy for I-680 corridor, as well as possible direct access to BART stations near I-680.
I-80/I-680/I-780 Transit Corridor Study	Solano County I-680, I-80, I-780	Study of existing and future transit service along the major corridors in Solano County.	STA	Completed July 2004	Considered future service needs and passenger support facility needs, including connections of Solano County services to the Pleasant Hill and Walnut Creek BART stations.	Presents existing and forecasted transit service and ridership, local demographics, and planned roadway improvements along I-680 corridor in Solano County. Identified connection needs to the Pleasant Hill and Walnut Creek BART stations.
Regional Rail Plan	Bay Area and beyond	50-year study horizon that explores improvements to rail, rapid transit, and high speed rail in the Bay Area and surrounding regions.	MTC	Revised Draft released September 2007	Draft report contains recommended improvements for twelve corridors throughout the region.	For the I-680/Tri-Valley corridor, the recommended plan calls for regional bus operation in the I-680 corridor, BART extension to a new ACE intermodal at Isabel/Stanley, and a significant upgrade of the ACE service.

TABLE 2-1
Relevant Studies

Study Name	Study Area	Study Description	Lead Agency	Status	Issues/Comments	Relevance to I-680 HOV/Express Bus Study
Regional High Occupancy Toll (HOT) Lanes Feasibility Study	Bay Area	Feasibility study for the implementation of a network of HOT lanes in the San Francisco Bay Area.	MTC	Completed in September 2007	Demand and revenue forecasts developed. Planned and robust HOV networks for model assumptions developed and confirmed.	Identifies future HOT lane locations along I-680.
MTC Transit Connectivity Study	Bay Area	Plan for improving connectivity at regional transit hubs.	MTC	Completed May 2006	Wayfinding, schedule coordination, real time technology, last mile and station amenities addressed.	Both the Pleasant Hill and Walnut Creek BART stations function as regional transit hubs and the wayfinding and other plan elements are therefore applicable.
MTC Regional Transit Expansion Program	Bay Area	Resolution 3434, the Regional Transportation Expansion Program, identifies specific bus, rail and ferry projects as priority for transit expansion.	MTC	Revised on April 26, 2006	Recommendations include $40M for “Regional Express Bus Phase 1.” I-680 is included in the proposed network.	Study must take into consideration regional express bus recommendation.
MTC HOV Master Plan	Bay Area	Provides a thorough review of current HOV lane performance, recommendations for how the HOV lane system could be expanded, and recommendations for expansion of the express bus operations in the region.	MTC	Completed in March 2003	The I-680 corridor was identified as one of the highest priorities for express bus system expansion. HOV lane gap closure and development of major express bus/HOV station in Walnut Creek are listed as priorities.	Study must take into consideration regional priorities regarding HOV lanes and express bus operations.
2005 Bay Area HOV Lanes Report	All state facilities with HOV lanes	Program encompasses monitoring of HOV lane volumes, relative HOV/SOV (single occupant vehicle) travel times where HOV lanes are present, HOV lane vehicle occupancy and violation rates.	Caltrans	Most recent report is for 2005	Monitoring is limited to a single point within each HOV lane segment.	Provides data for I-680 HOV lane in Contra Costa County - SB at truck scales; NB at Pacheco Blvd.
Walnut Creek BART Comprehensive Station Plan	Walnut Creek BART Station	This document identifies the needs of the Walnut Creek BART Station and establishes priorities for future planning and investment.	BART	Completed in June 2004	--	Provides information regarding the proposed Transit Oriented Development near Walnut Creek BART Station.

TABLE 2-1
Relevant Studies

Study Name	Study Area	Study Description	Lead Agency	Status	Issues/Comments	Relevance to I-680 HOV/Express Bus Study
Pleasant Hill BART Comprehensive Station Plan	Pleasant Hill BART Station	This document identifies the needs of the Pleasant Hill BART Station and establishes priorities for future planning and investment.	BART	Completed in July 2002	--	Provides information regarding the proposed Transit Oriented Development near Pleasant Hill BART Station.
2007 Congestion Management Program (CMP) Monitoring Report	Contra Costa County	Monitoring program addressing CMP Level of Service (LOS) Standards for both freeways and intersections.	CCTA	Draft Completed April 2008	Program examines intersection LOS based on TRB circular 212, and freeway LOS based on travel speeds. Freeway monitoring will utilize PeMS.	Provides limited data and LOS information for I-680 and several intersections within the study area.
2007 Traffic Service Objective Monitoring Report	Contra Costa County	Monitoring program addressing Measure C Traffic Service Objectives (TSOs).	CCTA	Completed 2007; Final publication 2008	Monitoring includes travel time information, vehicle occupancy, and level of service for key Contra Costa arterials and freeways within the county. TSO changes anticipated, but no change identified for I-680 yet.	Provides limited data/performance information for I-680 and the Pacheco/Contra Costa/N. Main corridor.
Central Contra Costa County Draft Action Plan	Central Contra Costa County	Policy Statement of intended actions for TRANSPAC, and statement of regional performance objectives.	CCTA	Last plan adopted 2000; update draft in 2008	Plan supports HOV lane gap closure, and endorses making improvements to I-680/SR 4.	Study must take into consideration improvements supported within Action Plan.
Tri-Valley Draft Action Plan	Alamo, Danville, San Ramon, Dublin, Pleasanton, and Livermore	Assesses transportation issues within the Tri-Valley area and outlines a recommended package of vision statements, goals, policies, objectives and actions for addressing those issues.	CCTA	Last plan adopted 2000; update draft in 2008	Plan supports HOV gap closure around SR 24 junction, improvements to San Ramon Valley Boulevard in Danville, system management strategies, and expanded bus service.	Study must take into consideration improvements supported within Action Plan.
Wayne Drive Flyover Study	I-680/Treat Boulevard/Geary Road Interchange	Studies the feasibility of a flyover off-ramp from I-680 SB to Wayne Drive. The flyover would cross over I-680 and Buskirk Avenue.	CCTA	Completed in February 1993	The alternative was identified as infeasible due to lack of a suitable location for relocating truck weigh station.	Provides possible connectivity improvements to the Pleasant Hill BART Station.

TABLE 2-1
Relevant Studies

Study Name	Study Area	Study Description	Lead Agency	Status	Issues/Comments	Relevance to I-680 HOV/Express Bus Study
CCCTA Short Range Transit Plan	Central Contra Costa County	Planning document that summarizes the planned County Connection improvements between years 2005 and 2014.	County Connection	Completed in June 2006	--	Provides proposed near term transit service improvements in Central Contra Costa County.
Fairfield Suisun Transit Short Range Transit Plan	Solano County	Planning document that summarizes the planned Fairfield & Suisun Transit improvements till year 2015.	FAST	Draft report completed in March 2007	--	Provides near term transit improvement proposals in Solano County.
LAVTA Short Range Transit Plan	Tri-Valley Area	Planning document that summarizes the planned WHEELS route improvements between years 2008 and 2017.	LAVTA	Completed in December 2007	--	Provides proposed near term transit connectivity changes between Central Contra Costa and Tri-Valley Area.
Vallejo Transit Short Range Transit Plan	City of Vallejo	Planning documents summarizing the near-term planned Vallejo Transit improvements.	Vallejo Transit	Completed in December 2001	--	Vallejo Transit does not currently operate service on the I-680 corridor. There is a proposal to begin to operate a Route 70 from Vallejo Transit, but that route is RM 2 funded and the final details of that route are currently under consideration.
San Ramon City Center EIR	City of San Ramon	Traffic study summarizing the environmental impacts related to the San Ramon City Center project.	City of San Ramon	Completed in October 2007	--	Provides proposed modifications to arterials parallel to I-680 and intersections located along them.

3.0 Existing and Future Conditions

This section provides a summary of the existing and future conditions for transit service and vehicle travel in the I-680 study corridor. Specific information is provided for the following:

- Current transit service in the study area, including a description of local and regional transit service, as well as transit centers and park-and-ride facilities.
- Planned transit service, including transit centers and Transit-Oriented Development (TOD), in the study area.
- Description of the corridor roadway network.
- Background traffic data for the freeways in the study area and on local streets in the vicinity of the Pleasant Hill and Walnut Creek BART stations.
- Existing traffic operating conditions on the freeways in the study area and on local streets in the vicinity of the Pleasant Hill and Walnut Creek BART stations.
- The 2010 and 2030 origin/destination patterns for sub-area to sub-area transit and HOV travel as derived using the CCTA Countywide Travel Forecasting Model.

3.1 Current Transit Service

The study area is served by public transit, with both local and regional service provided. Local transit service is primarily provided by the County Connection bus lines and regional transit service is provided by Amtrak, BART, Benicia Breeze, County Connection, Fairfield/Suisun Transit, and WHEELS. County Connection, Benicia Breeze, Fairfield/Suisun Transit, and WHEELS also serve as connectors to BART and Amtrak.

Figure 3-1 illustrates the existing transit routes that operate on the I-680 freeway, and also depicts the locations of the rail stations, transit centers, park-and-ride facilities, and key roadways in the study area. **Figures 3-2** and **3-3** illustrate the local transit services that serve the Walnut Creek BART Station and the Pleasant Hill BART Station, respectively. Key information regarding each transit route, including the termini of each route, period of operation, hours of operation, and headway, are provided in **Tables 3-1** and **3-2** for bus and rail routes in the study area, respectively.

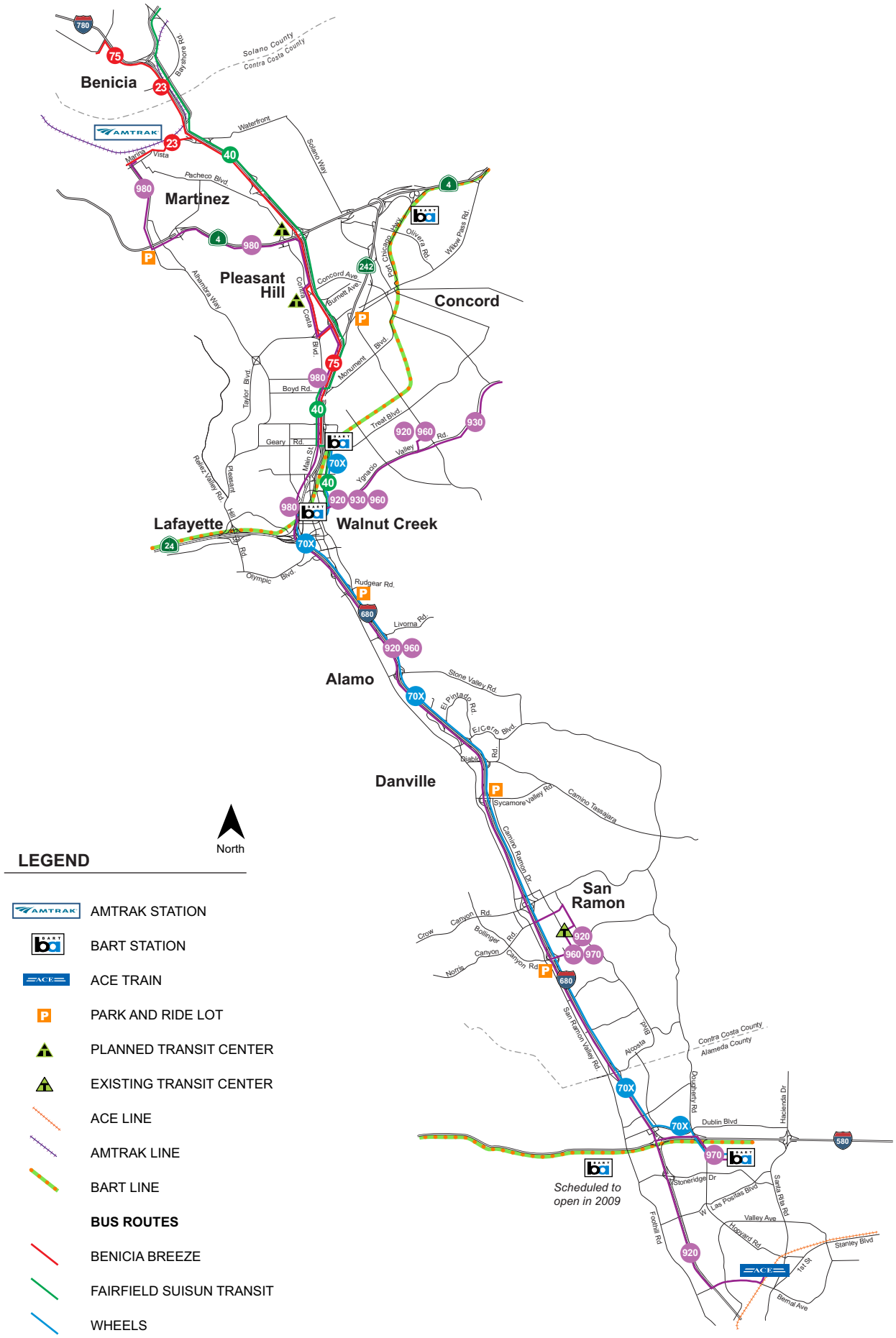
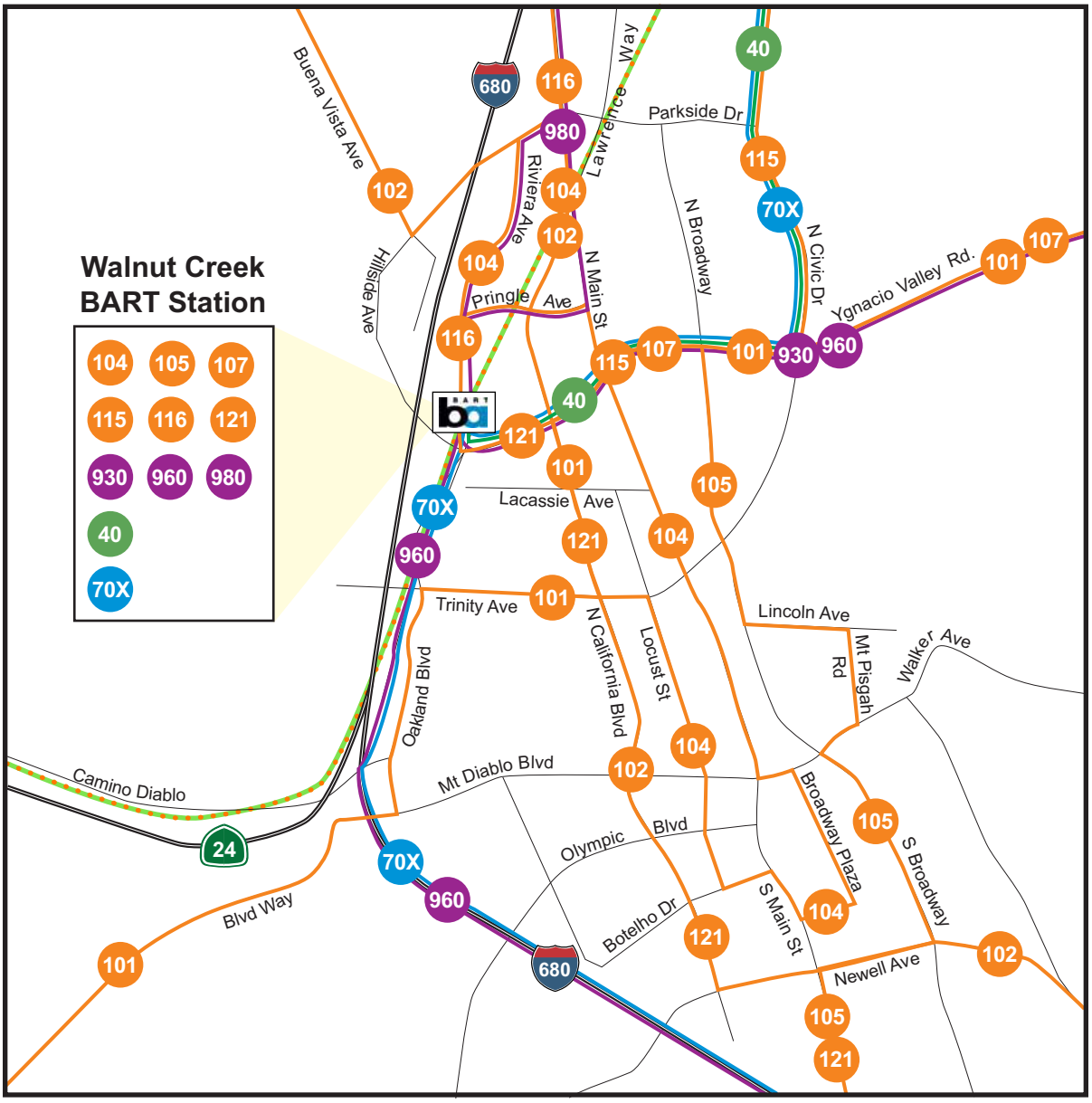


FIGURE 3-1
Regional and Express Bus Service Routes
I-680 HOV/Express Bus Access Study



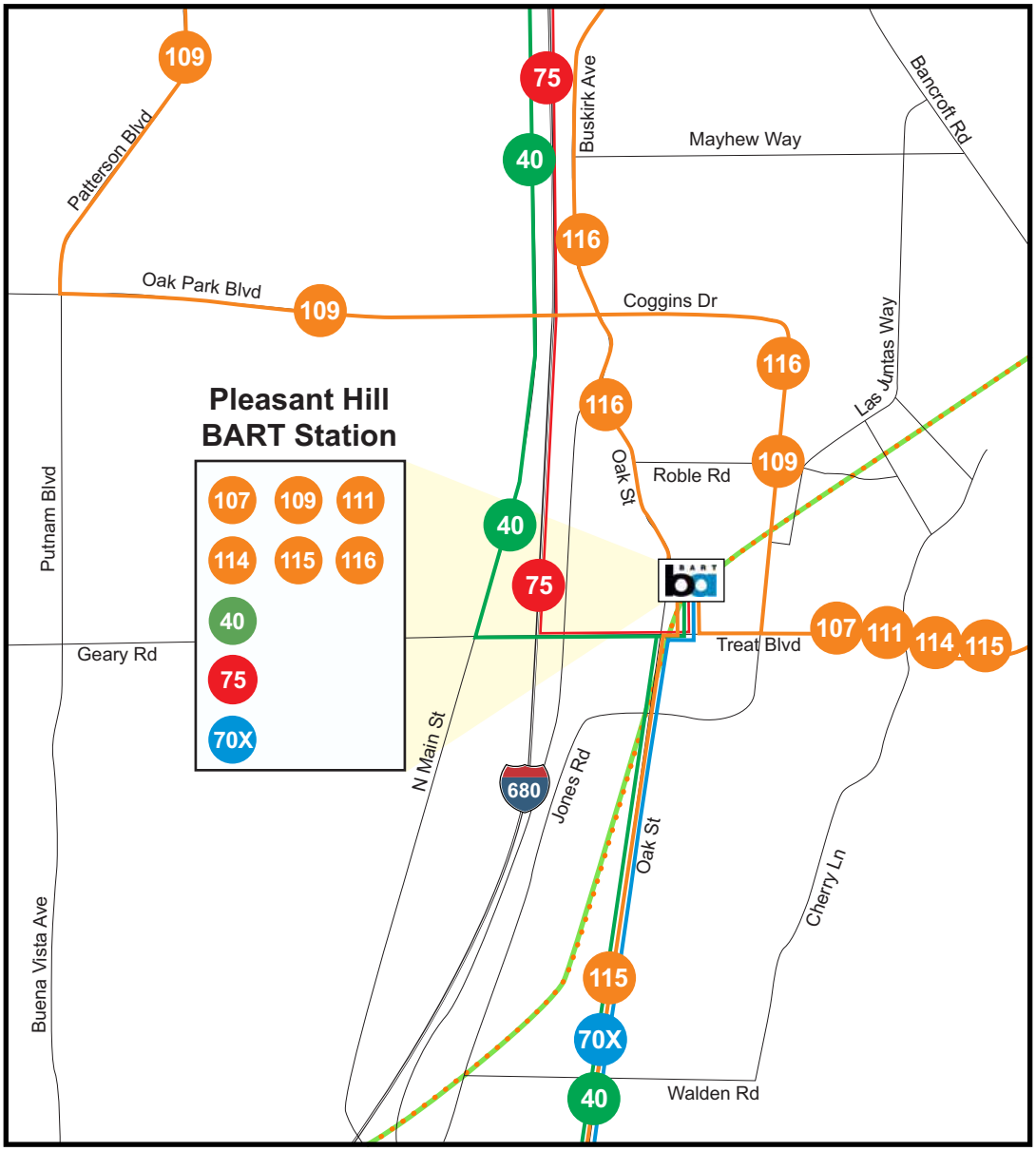
LEGEND

- BART STATION
- BART LINE

BUS ROUTES

- FAIRFIELD SUISUN TRANSIT
- WHEELS
- COUNTY CONNECTION – EXPRESS
- COUNTY CONNECTION – LOCAL

FIGURE 3-2
Bus Routes Accessing
Walnut Creek BART Station
I-680 HOV/Express Bus Access Study



North

LEGEND

- BART STATION
- BART LINE

BUS ROUTES

- BENICIA BREEZE
- FAIRFIELD SUISUN TRANSIT
- WHEELS
- COUNTY CONNECTION – LOCAL

FIGURE 3-3
Bus Routes Accessing Pleasant Hill BART Station
I-680 HOV/Express Bus Access Study

TABLE 3-1
Bus Services in the Study Area

Service Provider	Bus Rte.	Year 2007 Ridership	Dir.	From	To	Period of Operation	Hours of Operation	Headway (minutes)
Benicia Breeze	23	12,000	EB	Benicia	Martinez Amtrak	Weekday	At 5:50 AM	-
			WB	Martinez Amtrak	Benicia	Weekday	At 6:30 AM and 6:40 PM	-
Benicia Breeze	75	107,000	EB	Vallejo	Pleasant Hill BART	Weekday	5:35 AM to 7:30 PM	30 (peak) 60 (non peak)
						Saturday	7:46 AM to 5:30 PM	60
			WB	Pleasant Hill BART	Vallejo	Weekday	5:54 AM to 7:30 PM	30 (peak) 60 (non peak)
						Saturday	8:30 AM to 5:30 PM	60
Fairfield/Suisun Transit	40	33,233	EB	Vacaville	Walnut Creek BART	Weekday	6:26 AM to 8:51 AM 4:12 PM to 7:17 PM	16 to 45
		3,400 per month	WB	Walnut Creek BART	Vacaville	Weekday	5:00 AM to 7:15 AM 3:01 PM to 5:51 PM	16 to 45
WHEELS	70X	36,944	EB	Dublin/Pleasanton BART	Willow/Owens, Pleasanton	Weekday	3:10 PM, 4:10 PM, 4:40 PM, 5:10 PM	30 to 60
			WB	Willow/Owens, Pleasanton	Dublin/Pleasanton BART	Weekday	5:14 AM, 6:14 AM, 6:44 AM, 7:14 AM	30 to 60
County Connection	101	187,906	EB	Rossmoor Shopping Center, Walnut Creek	Mitchell Park 'n' Ride, Walnut Creek	Weekday	6:28 AM to 6:42 PM	20 (peak) 40 (non peak)
						Saturday	8:36 AM to 5:37 PM	33 to 60
			WB	Mitchell Park 'n' Ride, Walnut Creek	Rossmoor Shopping Center, Walnut Creek	Weekday	6:13 AM to 6:56 PM	20 (peak) 40 (non peak)
						Saturday	9:19 AM to 6:19 AM	26 to 60
County Connection	102	148,321	EB	Diablo Valley College	Trotter/Bridle, Walnut Creek	Weekday	6:12 AM to 6:40 PM	30 to 70
			WB	Trotter/Bridle, Walnut Creek	Diablo Valley College	Saturday	6:35 AM to 7:42 PM	5 to 70

TABLE 3-1
Bus Services in the Study Area

Service Provider	Bus Rte.	Year 2007 Ridership	Dir.	From	To	Period of Operation	Hours of Operation	Headway (minutes)
County Connection	104	242,640	RT	Walnut Creek BART	Walnut Creek BART	Weekday	7:10 AM to 6:55 PM	15
						Saturday	8:45 AM to 6:05 PM	20
						Sunday	9:10 AM to 6:10 PM	20
County Connection	105	41,142	EB	Walnut Creek BART	Creekside, Walnut Creek	Weekday	6:29 AM to 8:30 AM 3:03 PM to 7:02 PM	36 to 48 (AM) 12 to 54 (PM)
			WB	Creekside, Walnut Creek	Walnut Creek BART	Weekday	6:10 AM to 8:59 AM 3:36 PM to 6:34 PM	1 to 49 (AM) 41 to 52 (PM
County Connection	107	74,096	NB	Walnut Creek BART	Pleasant Hill BART	Weekday	6:25 AM to 6:20 PM	20 to 65
			SB	Pleasant Hill BART	Walnut Creek BART	Weekday	5:55 AM to 5:35 PM	15 to 65
County Connection	108	92,729	EB	Martinez Amtrak Station	North Concord/Martinez BART	Weekday	6:44 AM to 9:44 PM	17 to 69
			WB	North Concord/Martinez BART	Martinez Amtrak Station	Weekday	5:45 AM to 9:48 PM	45 to 69
County Connection	109	122,213	NB	Pleasant Hill BART	Diablo Valley College	Weekday	6:20 AM to 7:40 PM	40
						Saturday	10:23 AM to 6:23 PM	60
			SB	Diablo Valley College	Pleasant Hill BART	Weekday	6:55 AM to 10:10 PM	20 to 45
						Saturday	9:50 AM to 5:50 PM	60
County Connection	110	730,710	EB	Diablo Valley College	Marsh Creek/Clayton, Pleasant Hill	Weekday	5:00 AM to 10:10 PM	15 (till 8 PM) 24 to 36 (after 8 PM)
						Saturday	7:32 AM to 8:12 PM	40
			WB	Marsh Creek/Clayton, Pleasant Hill	Diablo Valley College	Weekday	5:25 AM to 10:29 PM	2 to 36
						Saturday	7:35 AM to 8:13 PM	40

TABLE 3-1
Bus Services in the Study Area

Service Provider	Bus Rte.	Year 2007 Ridership	Dir.	From	To	Period of Operation	Hours of Operation	Headway (minutes)
County Connection	111	122,654	NB	Pleasant Hill BART	Concord BART	Weekday	6:23 AM to 6:05 PM	17 to 69
						Saturday	7:30 AM to 7:05 PM	29 to 80
						Sunday	8:53 AM to 5:50 PM	29 to 77
			SB	Concord BART	Pleasant Hill BART	Weekday	6:01 AM to 6:50 PM	15 to 61
						Saturday	8:20 AM to 7:44 PM	15 to 80
						Sunday	8:20 AM to 6:35 PM	29 to 80
County Connection	114	385,363	EB	Pleasant Hill BART	Concord BART	Weekday	5:21 AM to 10:52 PM	15 to 45
			WB	Concord BART	Pleasant Hill BART	Weekday	6:07 AM to 10:58 PM	11 to 45
						Saturday	8:10 AM to 8:00 PM	25/30
County Connection	115	263,874	NB	Walnut Creek BART	Concord BART	Weekday	6:12 AM to 7:52 PM	20 to 40
						Saturday	9:14 AM to 7:00 PM	60
			SB	Concord BART	Walnut Creek BART	Weekday	5:43 AM to 7:13 PM	27 to 33
						Saturday	9:10 AM to 6:10 PM	60
County Connection	116	137,047	NB	Walnut Creek BART	Martinez Amtrak Station	Weekday	5:54 AM to 8:42 PM	45 to 69
						Saturday	10:10 AM to 7:10 PM	60
			SB	Martinez Amtrak Station	Walnut Creek BART	Weekday	5:40 AM to 7:31 PM	45 to 69
						Saturday	9:15 AM to 6:15 PM	60
County Connection	118	153,110	EB	Martinez Amtrak Station	Concord BART	Weekday	6:34 AM to 8:18 PM	22 to 60
						Saturday	8:29 AM to 6:29 PM	60
			WB	Concord BART	Martinez Amtrak Station	Weekday	5:47 AM to 7:47 PM	60
						Saturday	7:34 AM to 5:34 PM	60
County Connection	119	17,031	EB	Martinez Amtrak Station	Sunrise/Arthur, Martinez	Weekday	6:46 AM to 6:46 PM	60 to 120
			WB	Sunrise/Arthur, Martinez	Martinez Amtrak Station	Weekday	6:13 AM to 7:01 PM	48 to 120

TABLE 3-1
Bus Services in the Study Area

Service Provider	Bus Rte.	Year 2007 Ridership	Dir.	From	To	Period of Operation	Hours of Operation	Headway (minutes)
County Connection	121	311,652	NB	Dublin/Pleasanton BART	Walnut Creek BART	Weekday	5:10 AM to 10:12 PM	22 to 58
						Saturday	7:00 AM to 8:40 PM	65 to 80
						Sunday	9:20 AM to 5:20 PM	53 to 83
			SB	Walnut Creek BART	Dublin/Pleasanton BART	Weekday	5:25 AM to 8:40 PM	23 to 66
						Saturday	6:35 AM to 8:00 PM	60 to 80
						Sunday	8:45 AM to 4:40 PM	55 to 80
County Connection	127	39,025	NB	Diablo Valley College	North Concord/Martinez BART	Weekday	6:58 AM to 5:58 PM	60
			SB	North Concord/Martinez BART	Diablo Valley College	Weekday	6:32 AM to 5:32 PM	60
County Connection	135	29,694	NB	Dublin/Pleasanton BART	San Ramon Transit Center	Weekday	6:05 AM to 8:05 PM	15 to 55
			SB	San Ramon Transit Center	Dublin/Pleasanton BART	Weekday	5:30 AM to 7:30 PM	15 to 60
County Connection	221	16,773	NB	Pine Valley/Broadmoor, San Ramon	Alamo Plaza, Danville	Weekday	6:30 AM, 2:59 PM	-
			SB	Alamo Plaza, Danville	Dublin/Pleasanton BART	Weekday	6:45 AM, 7:15 AM, 3:00 PM	-
County Connection	308	6,806	EB	Martinez Amtrak	Concord BART	Sunday	9:00 AM to 5:00 PM	60
			WB	Concord BART	Martinez Amtrak	Sunday	9:40 AM to 4:20 PM	80
County Connection	920	42,504	NB	Pleasanton ACE Train Station	San Ramon Transit Center	Weekday	6:56 AM, 8:01 AM, 4:32 PM, 5:32 PM, 6:32 PM	-
			SB	San Ramon Transit Center	Pleasanton ACE Train Station	Weekday	5:54 AM, 6:50 AM, 3:39 PM, 4:39 PM, 5:39 PM	-
County Connection	930	32,397	EB	Walnut Creek BART	Hillcrest Park 'n' Ride, Antioch	Weekday	3:06 PM to 6:46 PM	30 to 60
			WB	Hillcrest Park 'n' Ride, Antioch	Walnut Creek BART	Weekday	5:27 AM, 5:53 AM, 6:26 AM, 7:07 AM	-

TABLE 3-1
Bus Services in the Study Area

Service Provider	Bus Rte.	Year 2007 Ridership	Dir.	From	To	Period of Operation	Hours of Operation	Headway (minutes)
County Connection	960B	171,832	NB	Bishop Ranch/Bollinger Canyon, San Ramon	Mitchell Park 'n' Ride, Walnut Creek	Weekday	5:55 AM to 9:23 AM, 12:25 PM, 2:45 PM to 7:00 PM	15 to 55 (AM) 17 to 43 (PM)
			SB	Mitchell Park 'n' Ride, Walnut Creek	Bishop Ranch/Bollinger Canyon, San Ramon	Weekday	5:15 AM to 7:45 AM, 1:32 PM, 6:03 PM	13 to 65 (AM)
	960C		NB	Crow Canyon/Crow Canyon Plaza, San Ramon	Mitchell Park 'n' Ride, Walnut Creek	Weekday	6:42 AM to 10:00 AM 3:27 PM to 7:02 PM	25 to 75 (AM) 27 to 50 (PM)
			SB	Mitchell Park 'n' Ride, Walnut Creek	Crow Canyon/Crow Canyon Plaza, San Ramon	Weekday	6:00 AM, 6:33 AM, 8:13 AM, 6:25 PM	-
County Connection	970B	55,301	RT	Dublin/Pleasanton BART Station	Dublin/Pleasanton BART Station	Weekday	6:35 AM to 9:15 AM 3:30 PM to 6:00 PM	25 to 45 (AM) 30 to 75 (PM)
	970C		RT	Dublin/Pleasanton BART Station	Dublin/Pleasanton BART Station	Weekday	6:44 AM, 7:14 AM, 7:43 AM, 3:10 PM to 5:33 PM	15 to 57 (PM)
County Connection	980	70,357	NB	Walnut Creek BART	Martinez Amtrak Station	Weekday	5:49 AM to 6:35 PM	30 to 58
			SB	Martinez Amtrak Station	Walnut Creek BART	Weekday	5:40 AM to 6:45 PM	25 to 60

Notes:
EB = eastbound; NB = northbound; RT = round trip; SB = southbound; WB = westbound

TABLE 3-2
Rail Services in the Study Area

Service Provider	Station	Year 2007 Ridership	Transit Route				Period of Operation	Hours of Operation	Headway (minutes)
			Line	Dir.	From	To			
BART	Walnut Creek	5,887[1]	Yellow	NB	San Francisco Int'l Airport	Pittsburg/Bay Point	Weekday	4:59 AM to 1:03 AM	3 to 19
							Saturday	7:11 AM to 1:03 AM	20 (till 7 PM) 15 (after 7 PM)
							Sunday/ Holiday	8:45 AM to 1:03 AM	15
				SB	Pittsburg/Bay Point	San Francisco International Airport	Weekday	4:20 AM to 12:17 AM	4 to 15
							Saturday	6:15 AM to 12:17 AM	20 (till 6:35 PM) 15 (after 6:35 PM)
							Sunday/ Holiday	8:20 AM to 12:17 AM	15
BART	Pleasant Hill	6,030[1]	Yellow	NB	San Francisco International Airport	Pittsburg/Bay Point	Weekday	5:02 AM to 1:06 AM	3 to 19
							Saturday	7:14 AM to 1:06 AM	20 (till 7 PM) 15 (after 7 PM)
							Sunday/ Holiday	8:48 AM to 1:06 AM	15
				SB	Pittsburg/Bay Point	San Francisco International Airport	Weekday	4:17 AM to 12:14 AM	4 to 15
							Saturday	6:12 AM to 12:14 AM	20 (till 6:35 PM) 15 (after 6:35 PM)
							Sunday/ Holiday	8:17 AM to 12:14 AM	15

TABLE 3-2
Rail Services in the Study Area

Service Provider	Station	Year 2007 Ridership	Transit Route				Period of Operation	Hours of Operation	Headway (minutes)
			Line	Dir.	From	To			
Amtrak	Martinez	341,555	Capitol Corridor	EB	San Jose	Reno	Weekday	5:19 AM to 10:09 PM	40 to 90
							Weekend/ Holiday	8:09 AM to 9:44 PM	60 to 120
				WB	Reno	San Jose	Weekday	5:30 AM to 10:10 PM	40 to 120
							Weekend/ Holiday	6:40 AM to 10:10 PM	60 to 125
Amtrak	Martinez		California Zephyr	EB	San Francisco	Chicago	Daily	8:49 AM	-
				WB	Chicago	San Francisco	Daily	5:24 PM	-
Amtrak	Martinez		Coast Straight	NB	Los Angeles	Seattle	Daily	10:54 PM	-
				SB	Seattle	Los Angeles	Daily	7:34 AM	-
Amtrak	Martinez		San Joaquins	NB	Bakersfield	Oakland	Daily	10:03 AM, 3:34 PM, 6:28 PM, 9:01 PM	-
				SB	Oakland	Bakersfield	Daily	8:19 AM, 10:54 AM, 1:54 PM, 6:39 PM	-

Notes:
[1] Average weekday exits
EB = eastbound; NB = northbound; SB = southbound; WB = westbound

3.1.1 Regional Transit Service

BART is the San Francisco Bay Area's regional rapid rail service connecting San Francisco with the East Bay and the Peninsula. BART's Pittsburg/Bay Point - Daly City line, serves central Contra Costa County, providing linkages to San Francisco, the East Bay, and other regional transit lines including AC Transit, Caltrain, County Connection, Dumbarton Express, Golden Gate Transit, S.F. Muni (San Francisco Municipal Railway), SamTrans, Santa Clara Valley Transportation Authority, Union City Transit, Vallejo Transit, and WestCAT. The following two BART stations are located within the study area:

- Walnut Creek BART Station
- Pleasant Hill BART Station

Amtrak provides intercity passenger rail service throughout the United States. Amtrak operates as an out-of-region transit provider for the study area. The Amtrak station located in Martinez serves the study area. Transit connections are provided to Oakland, San Jose, Sacramento, Bakersfield, Los Angeles, Chicago, Seattle, and Portland using the following four routes:

- Capitol Corridor (Auburn, CA – San Jose, CA)
- California Zephyr (Chicago, IL – San Francisco, CA)
- Coast Starlight (Seattle, WA – Los Angeles, CA)
- San Joaquins (San Francisco, CA - Bakersfield, CA)

Benicia Breeze is a local and regional bus service serving Solano and Contra Costa Counties. It provides local transit service in the City of Benicia and intercity commute service between Vallejo, Benicia, Martinez, Concord, and Pleasant Hill. Within the study area, Benicia Breeze operates Routes 23 and 75 to the Amtrak and BART stations. Route 23 provides express commuter service between Benicia and the Martinez Amtrak Station during the morning and evening peak hours. It serves as a connector to the Capitol Corridor. Route 75 provides express bus service between Vallejo and the Pleasant Hill BART Station and serves as a BART connector.

Fairfield & Suisun Transit provides local transit service in the Solano County cities of Fairfield (which consists of the Travis Air Force Base and the Cordelia Village Area) and Suisun. It also operates intercity bus service that connects Fairfield to the outlying cities of Vacaville, Davis, Sacramento, and Pleasant Hill. Within the study area, Fairfield/Suisun Transit operates Route 40 (Solano BART Express). This route provides express bus service between Vacaville and the Walnut Creek and Pleasant Hill BART stations during weekday peak period.

WHEELS is the local public bus service operated by the Livermore Amador Valley Transit Authority (LAVTA) for the Cities of Livermore, Pleasanton, and Dublin. The WHEELS network serves most of the major destinations in the Livermore-Amador Valley including the Lawrence Livermore Lab, downtown Livermore, downtown Pleasanton, Hacienda Business Park, BART, Stoneridge Mall, and most of the high schools. WHEELS local bus routes also provide direct connections with BART and County Connection at the Dublin/Pleasanton BART station. It provides fixed bus service in the Tri-Valley Area and express bus service to central Contra Costa County and the Silicon Valley. Within the study

area, WHEELS operates commute period express service (Route 70X) connecting the Dublin/Pleasanton, Walnut Creek, and Pleasant Hill BART stations.

3.1.2 Local Transit Service

County Connection provides fixed route and paratransit service throughout central Contra Costa County with connections to Alameda County (Dublin and Pleasanton) and East Contra Costa County (Antioch). County Connection serves Clayton, Concord, Danville, Lafayette, Martinez, Moraga, Orinda, Pleasant Hill, San Ramon, Walnut Creek, and unincorporated areas of Central County. Within the study area, County Connection operates the following 24 bus routes:

- ***Route 101*** serves the City of Walnut Creek. It provides service between the Rossmoor Shopping Center and the Mitchell Park-and-Ride Lot via John Muir Medical Center, Walnut Creek BART Station, Shadelands Business Park, and Jewish Community Center.
- ***Route 102*** is an intercity bus service serving the cities of Pleasant Hill and Walnut Creek. It operates as a transit connector between the Diablo Valley College and the Walnut Creek BART Station while serving the Sun Valley Mall, Pleasant Hill Road (Pleasant Hill), and Trotter Way (Walnut Creek).
- ***Route 104*** is a trolley-type downtown circulator that serves downtown Walnut Creek and Walnut Creek BART Station.
- ***Route 105*** operates along Broadway and Creekside Drive located in the City of Walnut Creek. It connects the Walnut Creek BART Station with the Broadway Shopping Center.
- ***Route 107*** serves primarily as a BART connector and provides service between the Walnut Creek BART Station, Marchbanks Drive (Walnut Creek), the Mitchell Park-and-Ride Lot, Ygnacio Valley Road, Walnut Avenue, and the Pleasant Hill BART Station.
- ***Route 108*** is an intercity bus service serving the cities of Martinez, Pleasant Hill, and Concord. It provides service between the Martinez Amtrak Station, Diablo Valley College, and the North Concord/Martinez BART Station.
- ***Route 109*** serves the City of Pleasant Hill. It provides service between the Diablo Valley College and the Pleasant Hill BART Station while connecting Contra Costa Boulevard, Ellinwood Complex, and John F. Kennedy University.
- ***Route 110*** connects the cities of Pleasant Hill, Concord, and Clayton. It connects the Diablo Valley College with the Concord BART Station and serves Clayton Road and the Sun Valley Mall.
- ***Route 111*** provides bus service between the Pleasant Hill and Concord BART stations along Oak Grove Road.
- ***Route 114*** connects the Pleasant Hill and Concord BART stations and serves Monument Boulevard.

- ***Route 115*** serves the cities of Walnut Creek, Pleasant Hill, and Concord. It provides service between the Walnut Creek BART Station, the Pleasant Hill BART Station, Treat Boulevard, and the Concord BART Station.
- ***Route 116*** provides service between the Martinez Amtrak Station, Alhambra Avenue, Pleasant Hill Road, the Pleasant Hill BART Station, and the Walnut Creek BART Station.
- ***Route 118*** provides transit service from the Martinez Amtrak Station to the Concord BART Station, while serving Diablo Valley College, Morello Avenue, and Concord Avenue.
- ***Route 119*** provides bus service within the City of Martinez along Pacheco Boulevard. It connects the Amtrak Station with the communities located in southeast Martinez.
- ***Route 121*** provides regional bus service between the cities of Dublin, Pleasanton, San Ramon, Danville, Alamo, and Walnut Creek. It serves the Dublin/Pleasanton BART Station, the San Ramon Transit Center, and the Walnut Creek BART Station using major arterials parallel to I-680, including Village Parkway, San Ramon Valley Boulevard, Bollinger Canyon Road, Camino Ramon, Danville Boulevard, South Main Street, and California Boulevard.
- ***Route 127*** serves the City of Concord. It provides service between the North Concord/ Martinez BART Station and the Diablo Valley College via Heald College, Bates Avenue, and Marsh Drive.
- ***Route 135*** operates as an intercity bus service connecting the cities of San Ramon, Dublin, and Pleasanton. It serves the San Ramon Transit Center and the Dublin/ Pleasanton BART Station using Dougherty Road.
- ***Route 221*** is a limited weekday bus service connecting the Alamo Plaza (Danville) with the Dublin/Pleasanton BART Station via San Ramon Valley Boulevard and Dougherty Road.
- ***Route 308*** provides bus service during Sundays and holidays between the Martinez Amtrak Station, the Contra Costa Regional Medical Center, the John Muir National Historic Site, and the Concord BART Station.
- ***Route 920*** (ACE Express) provides express bus service during the weekday morning and evening peak periods between the Mitchell Park-and-Ride Lot (Walnut Creek), the Danville Park-and-Ride Lot, the San Ramon Transit Center, and the Pleasanton Altamont Commuter Express Train Station. This bus route commutes on I-680 between Ygnacio Valley Road and Crow Canyon Road interchanges and between Bollinger Canyon Road and Bernal Avenue interchanges.
- ***Route 930*** is an express bus service operating during weekday peak period between the cities of Walnut Creek, Concord, Pittsburg, and Antioch. It connects the Walnut Creek BART Station, the John Muir Medical Center, the Mitchell Park-and-Ride Lot, and the Hillcrest Park-and-Ride Lot.

- ***Routes 960B and 960C*** operate in the cities of Walnut Creek, Danville, and San Ramon. They provide a weekday bus service between the Mitchell Park-and-Ride Lot, the Walnut Creek BART Station, the Danville Park-and-Ride Lot, the San Ramon Transit Center, and Bishop Ranch. These bus routes serve as BART connectors, commuting on I-680 between Ygnacio Valley Road and Bollinger Canyon Road interchanges.
- ***Routes 970B and 970C*** provide bus service during weekday peak period between the City of San Ramon, Bishop Ranch, and the Dublin/Pleasanton BART Station. These bus routes commute on I-680 between the Crow Canyon Road and I-580 interchanges.
- ***Route 980*** provides weekday express bus service connecting the Martinez Amtrak Station, the Contra Costa Regional Medical Center, and the Walnut Creek BART Station.

3.1.3 Transit Centers in the I-680 Corridor

There are six transit centers in the study corridor, as summarized in **Table 3-3**.

TABLE 3-3
Transit Centers Located in the Study Area

Transit Center	Transit Provider	Serving Routes
Walnut Creek BART Station	County Connection	101, 102, 104, 105, 115, 116, 121, 930, 960B, 960C
	WHEELS	70X
	Fairfield Suisun Transit	40
San Ramon Transit Center	County Connection	121, 135, 920/ACE Express, 960B, 960C, 970B, 970C
Pleasant Hill BART Station	County Connection	107, 109, 111, 114, 115, 116
	Benicia Breeze	75
	Fairfield/Suisun Transit	40
	WHEELS	70X
Martinez Amtrak Station	Benicia Breeze	23
	WestCAT	30Z
	Tri Delta Transit	200
	County Connection	108, 116, 118, 128, 308

3.1.4 Park-and-Ride Lots in the I-680 Corridor

Park-and-ride lots facilitate the formation of carpools or vanpools. They are served by transit (local and sometimes express routes) and some have bike lockers, which allow non-drivers to meet their carpool partners conveniently.

There are six park-and-ride lots in the I-680 corridor, presented in **Table 3-4**.

TABLE 3-4
Park-and-Ride Lots Located in the Study Area

City	Location[1]	Spaces[1]	Utilization	Transit Provider	Routes
Concord	SR 242 at Willow Pass Road and Market Street	45	33.3%[2]	None	N/A
Danville	I-680 at Sycamore Valley Road	240	Half full[3]	County Connection	121, 960
Martinez	Pacheco Boulevard at Blum Road (north of SR 4)	51	102%[2]	None	N/A
Martinez	SR 4 at Alhambra Avenue	24	Unknown	None	N/A
San Ramon	I-680 at Bollinger Canyon Road	108	32.4%[2]	None	N/A
Walnut Creek	I-680 at Rudgear Road	64	79.7%[2]	None	N/A

Notes:
[1] Source: http://rideshare.511.org/park_lots/
[2] Caltrans, 2007
[3] Source: City of San Ramon, 2007

3.2 Planned Transit Service

3.2.1 Planned Transit Centers along the I-680 Corridor

The following two transit centers are planned along the I-680 corridor within the study area:

- Pacheco Transit Center
- Diablo Valley College Transit Center

Pacheco Transit Center is proposed in the City of Martinez at the intersection of Pacheco Boulevard and Blum Road. The project would expand the existing park-and-ride lot and double the number of parking spaces from 51 to 104. In addition, six bus bays would be provided that would serve the County Connection, the WestCAT, and the Tri-Delta buses. Route 980 of County Connection would operate at this transit hub. Additional routes will be identified as part of an effort to restructure local and regional transit service serving the City of Martinez.

Diablo Valley College Transit Center is proposed in the City of Pleasant Hill. This transit center would include eight bus bays and one designated area to serve the paratransit service, with room for two additional bus bays in the future. However, no parking provisions are provided for park-and-ride patrons. County Connection Routes 102, 108, 109, 110, 118, 127, and 314 are expected to serve this transit center. The project is currently at the conceptual design level.

Table 3-5 summarizes the planned transit centers within the study area.

TABLE 3-5
Planned Transit Centers in the Study Area

Transit Center	Transit Provider	Probable Serving Routes
Pacheco Transit Center	County Connection	980, TBD
	WestCAT	TBD
	Tri-Delta	TBD
Diablo Valley College Transit Center	County Connection	102, 108, 109, 110, 118, 127, 314

Notes:
TBD – To be determined

3.2.2 Planned Transit Service along the I-680 Corridor

Limited information was available regarding future changes in transit service in the I-680 corridor. For the most part, the various transit operators are focused on managing their current system within budget restrictions. **County Connection** is planning an updated Express Bus Study, which would provide guidance for future transit service changes.

Benicia Breeze is currently considering modifications to Route 75 that would shift it from a Benicia-subsidized service to a service that would be subsidized by Regional Measure 2 and the Intercity Funding Agreement. The proposal is currently being finalized. To qualify as a regional route, potential route changes would be required. These changes include reduced stops and local street use in Benicia, removal of stops in the Sun Valley Mall, and extension of service to the Walnut Creek BART Station to connect with County Connection and LAVTA buses (as well as Downtown Walnut Creek). The operator of this service is yet to be determined. Vallejo Transit may become the operator of the restructured Route 75, depending on implementation strategies currently under consideration through the Solano Intercity Transit Funding Agreement and associated service plans.

A supplemental bus service would operate to connect Benicia with the Sun Valley Mall and Diablo Valley College. This service would be an overlay service.

Tri-Delta Transit, which served Eastern Contra Costa, has the following planned improvements to its bus routes that could allow it to serve the study area:

- It has conceptual plans to add a stop on Route 200 (operating between Martinez Amtrak and Contra Costa Social Service) if Pacheco Transit Center is operational.
- Depending on the destinations of subscription riders, Delta Express, a single-trip subscription commuter service connecting East Contra Costa County with the county administrative offices, may also be provided a stop at Pacheco Transit Center.
- Although there are no plans to use the I-680 corridor for Route 201 (operating between Concord BART and Pittsburg/Bay Point BART Stations), this route may be redirected to serve new transit hubs (Pacheco Transit Center and Diablo Valley College Transit Center) if demand warrants.

- New routes may be considered for the express/subscription commute service, such as to and from San Ramon employment sites. These new routes might use the I-680 corridor.

3.2.3 Planned TOD Development

Transit-Oriented Development, which Caltrans defines as "a moderate to higher-density development located within an easy walk of a major transit stop, generally with a mix of residential, employment and shopping opportunities designed for pedestrians" (Caltrans, 2008), is planned at the Walnut Creek and Pleasant Hill BART Stations. Construction on the Pleasant Hill BART Station TOD has begun with the construction of a new parking garage.

3.3 Study Area Roadway Network

The roadway network in the study area consists of one major freeway (I-680) and many arterials running parallel to I-680 in the north-south direction. The key roadway facilities were illustrated in **Figure 1-1**. A description of the study roadway network is provided below.

3.3.1 I-680 Freeway

The corridor's main transportation feature is I-680, which runs north-south through the study area and is the major freeway connection between Solano County to the north and Alameda and Santa Clara Counties to the south.

The study freeway segment of I-680 from the Alameda County line to the Solano County line is approximately 29 miles in length. North of SR 24, the surrounding land use is suburban in nature and consists of industrial development near the foot of the Benicia-Martinez Bridge, light commercial and industrial development towards SR 4, and denser residential and commercial development south of SR 242 through Pleasant Hill and Walnut Creek. South of SR 24, development is primarily single-family residential housing, with commercial and retail zones in southern Walnut Creek, the Town of Danville, and the City of San Ramon. The number of freeway lanes increases from three lanes in each direction near Martinez and Pacheco to six lanes in each direction near Walnut Creek and then decreases to four/five lanes in each direction near Danville and San Ramon.

Interchanges on this roadway segment are generally spaced at one- to two-mile intervals. The study freeway segment encompasses 24 interchanges, including 4 freeway-to-freeway interchanges that provide access to the rest of the Bay Area freeway network. The freeway-to-freeway interchanges are located at:

- Postmile 29 (I-680/I-580)
- Postmile 45 (I-680/SR 24)
- Postmile 50 (I-680/SR 242)
- Postmile 53 (I-680/SR 4)

Table 3-6 is a summary of the freeway segment roadway geometric configuration. The number of lanes between each set of interchanges is shown on the shaded lines between the interchange names.

TABLE 3-6
I-680 Geometric Configuration

Interchange	Number of Lanes Between Interchanges					
	Southbound			Northbound		
	Mainline	Auxiliary	HOV	Mainline	Auxiliary	HOV
Solano County Line						
	3	0	0	3	0	0*
Marina Vista Avenue/Waterfront Road						
	3	0	1	3	1	0
Arthur Road/Pacheco Boulevard						
	3	0	1	3	0	1
SR 4						
	3	1	1	3	0	1
Contra Costa Boulevard/Concord Avenue						
	3	1	1	3	1	1
Willow Pass Road						
	3	1	1	3	0	1
SR 242						
	5	0	1	3	3	0
Monument Boulevard						
	5	1	1	5	1	0
Contra Costa Boulevard						
	5	1	1	5	1	0
Geary Boulevard/Treat Road						
	5	1	1	5	1	0
North Main Street						
	4	2	0	5	1	0
SR 24 Off (SB)/On (NB)						
	4	0	0	3	1	0
SR 24 On (SB)/Off (NB)						
	5	1	0	3	2	0
South Main Street						
	5	0	0	5	0	0
Rudgear Road						
	3	1	0	4	0	0
Livorna Road						
	3	0	1	3	0	1
Stone Valley Road						
	3	0	1	3	0	1
El Pintado Road						
	3	0	1	3	0	1
El Cerro Road						
	3	1	1	3	1	1
Diablo Road						
	3	0	1	3	0	1

TABLE 3-6
I-680 Geometric Configuration

Interchange	Number of Lanes Between Interchanges					
	Southbound			Northbound		
	Mainline	Auxiliary	HOV	Mainline	Auxiliary	HOV
Sycamore Valley Road						
	3	0	1	3	0	1
Crow Canyon Road						
	3	1	1	3	1	1
Bollinger Canyon Road						
	3	0	1	3	0	1
Alcosta Boulevard						
	4	1	1	3	1	1
I-580						

Note:
* 3+ HOV toll bypass lanes during peak commute periods on NB I-680 at the Benicia-Martinez Bridge Toll Plaza

Within the study area, HOV lanes are provided along I-680 at the following locations:

Northbound Direction
- Between I-580 and Livorna Road interchanges
- Between SR 242 and Arthur Road/Pacheco Boulevard interchanges

Southbound Direction
- Between Marina Vista Avenue/Waterfront Road and North Main Street interchanges
- Between Livorna Road and I-580 interchanges

The HOV lanes are in operation during weekdays from 6:00 AM to 9:00 AM and from 3:00 PM to 7:00 PM, and are restricted to vehicles with two or more occupants. There are no direct access ramps to or from the HOV lanes; all HOV lane traffic must enter from a mixed-flow lane.

3.3.2 Major Parallel Arterials

CCTA, in consultation with TRANSPAC, SWAT, and the Tri-Valley Transportation Council (TVTC), has designated several roadways in this area as Routes of Regional Significance. As such, these routes are subject to Multi-modal Transportation Service Objectives (MTSOs), as set forth in the Action Plans and the countywide plan. Other arterials that are not designated as Regional Routes are subject to Measure C Level of Service (LOS) standards. Note that LOS standards for these routes were discontinued as of April 1, 2009.

The major arterial routes that run north-south (parallel to I-680) in the study area include:

- **San Ramon Road/San Ramon Valley Boulevard/Hartz Avenue/Danville Boulevard/ South Main Street** runs parallel to I-680 on the west side from I-580 to SR 24, except for a portion of South Main Street that runs on the east side of I-680. It is four lanes wide through San Ramon and Walnut Creek, but only two lanes wide through most of Danville. Typically, there are left-turn bays at major intersections. This roadway is designated as a Route of Regional Significance.

- **North California Boulevard/North Main Street/Contra Costa Boulevard/Pacheco Boulevard** is a major north-south arterial serving the cities of Walnut Creek, Pleasant Hill, and Martinez. It is four lanes wide south of SR 4 and two lanes wide north of SR 4. A major portion of the arterial runs parallel to I-680 on the east side. Portions of these roadways located north of I-680 are designated as a Route of Regional Significance.
- **Alcosta Boulevard** crosses I-680 at the south end of the study corridor, but then runs northward and parallels I-680 through San Ramon. The divided roadway has two lanes in each direction. The City of San Ramon General Plan designates this roadway as an Arterial Street.
- **Camino Ramon** is a two-lane roadway running parallel to I-680 on the east side between Fostoria Way and Sycamore Valley Boulevard in the Town of Danville. The Town of Danville General Plan designates this roadway as a Major Collector Street from Sycamore Valley Boulevard to Greenbrook Drive and as a Neighborhood Collector Street from Greenbrook Drive to the San Ramon city limits.
- **Dougherty Road** today is a rural roadway, but is designed to serve a newly developing area of Contra Costa County that will be annexed to San Ramon. Located about two miles east of I-680, it currently carries two lanes of traffic in each direction, with additional lane width available. Plans for widening and for developing in this corridor continue to be revised based on local policy direction. This roadway is designated as a Route of Regional Significance.
- **Trinity Avenue/Civic Drive/Oak Road** is a four-lane roadway in Walnut Creek connecting Oakland Boulevard with Treat Boulevard. This roadway crosses I-680 north of SR 24, but north of the crossing it runs parallel to I-680. The City of Walnut Creek General Plan classifies this roadway as an Arterial from Treat Boulevard to North California Boulevard and as a Collector west of North California Boulevard.

3.4 Background Traffic Data

DKS Associates compiled a variety of relevant traffic-related data for the I-680 HOV/Express Bus/project from various sources including the Caltrans Census, Caltrans Annual HOV Lane Report, and new primary counts.

3.4.1 Freeway Mainline and Ramp Traffic Counts

Traffic volume count data for all ramps and select mainline locations within the study area were provided by Caltrans. These data were collected as part of Caltrans' Traffic Census program in 2006.

3.4.2 Vehicle Occupancy Survey Data

Freeway AM and PM peak period vehicle occupancy survey data for various locations along I-680 are summarized in **Table 3-7**. These data were obtained from various sources including new counts conducted for this study, Caltrans' Annual HOV Lane Report, and CCTA's Draft 2007 Traffic Safety Objective (TSO) Monitoring Report (CCTA, 2007). The data for the Benicia-Martinez Bridge toll plaza were provided by Caltrans. These counts were conducted only for northbound I-680 in September 2007 after the opening of the new bridge and toll plaza.

TABLE 3-7
I-680 Mainline Vehicle Occupancy Rates

Location	Source	Year	Average Occupancy	
			AM Peak	PM Peak
I-680 Northbound				
Oak Park Boulevard (all lanes)	DKS Counts	2008	1.12	1.20
SR 242 to Marina Vista Avenue (at Pacheco Boulevard)	Caltrans Annual HOV Lane Report	2007	1.2	1.3
I-680 at north of SR 242 Flyover (peak direction)	Draft 2007 TSO Monitoring Report	2007	1.25	1.31
Benicia Bridge Toll Plaza	Caltrans - Benicia Bridge Count	2007	1.2	1.3
I-680 Southbound				
I-680 north of SR 242 Flyover (peak direction)	Draft 2007 TSO Monitoring Report	2007	1.25	1.31
Oak Park Boulevard (all lanes)	DKS Counts	2008	1.23	1.21
Oak Park Boulevard (HOV lane only)	DKS Counts	2008	1.73	1.76
Marina Vista to North Main St. (at truck scale)	Caltrans Annual HOV Lane Report	2007	1.3	1.3

Source: DKS Associates, 2008

It should be noted that the average vehicle occupancy in the southbound HOV lane was less than 2 persons per vehicle due to the following reasons:

- Single-occupant hybrid vehicles traveling in the HOV lane;
- Unaccounted-for occupants such as small children in back seat;
- Motorcycles; and
- Violators.

In addition to the mainline vehicle occupancy counts, DKS also collected vehicle occupancy data for several on-and-off ramps along I-680. The count locations are illustrated in **Figure 3-4**. **Table 3-8** shows total traffic, HOV traffic, and occupancy rate in the peak period.

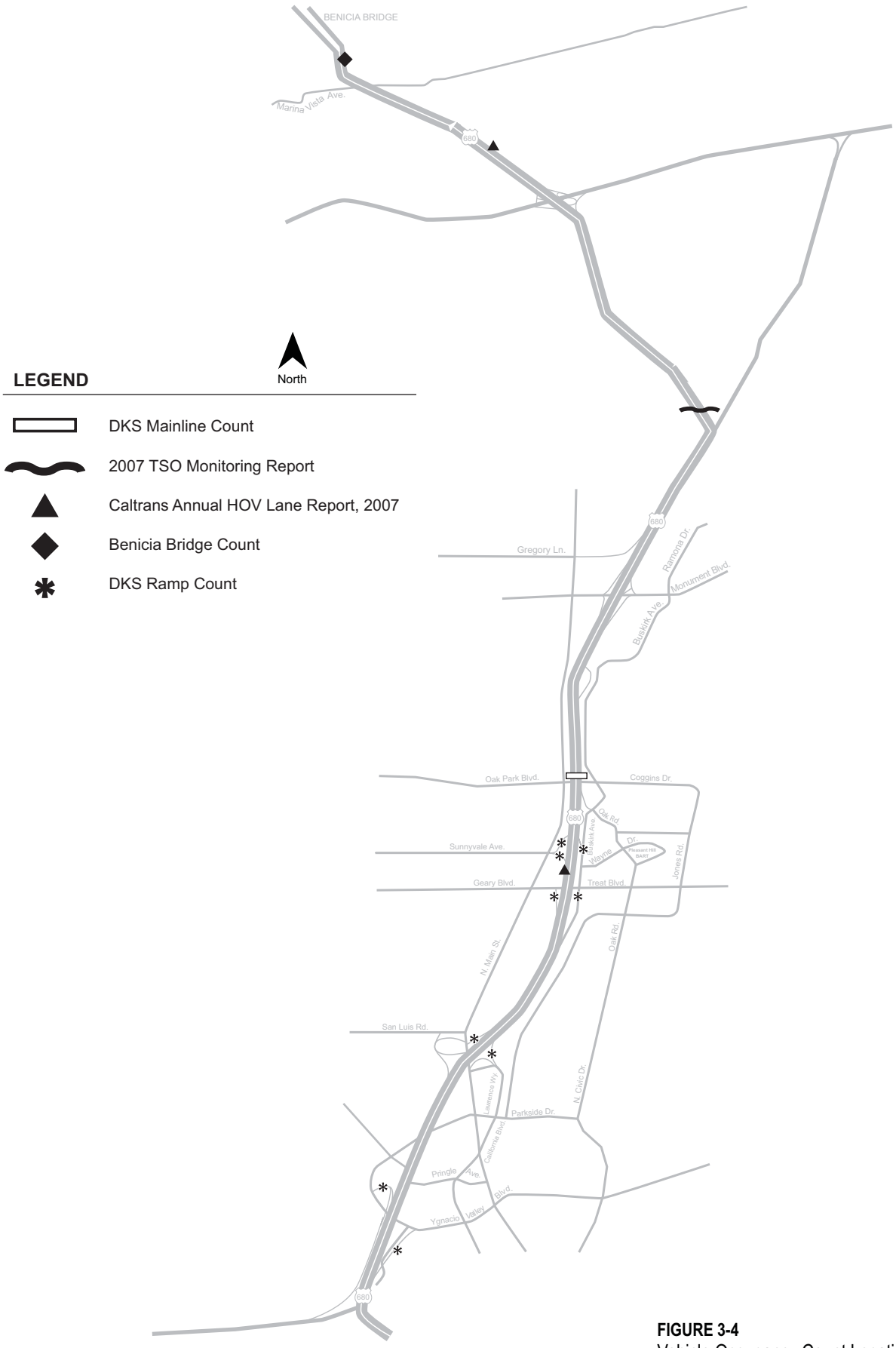


FIGURE 3-4
Vehicle Occupancy Count Locations
I-680 HOV/Express Bus Access Study

Source: DKS Associates, 09/2008.

TABLE 3-8
Average Vehicle Occupancy on I-680 On-and-Off-Ramps

Ramp	Peak Period (6:00 AM - 9:00 AM)			Peak Hour (7:30 AM - 8:30 AM)		
	Total (veh)	HOVs (veh)	Avg. Occu-pancy	Total (veh)	HOVs (veh)	Avg. Occu-pancy
NB I-680 off-ramp to Ygnacio Valley Road	3,337	513	1.18	1,299	249	1.23
NB I-680 on-ramp from N. Main Street	1,975	238	1.14	897	105	1.14
NB I-680 off-ramp to Treat Boulevard	3,240	293	1.10	1,658	184	1.13
NB I-680 on-ramp from Treat Boulevard/Buskirk Avenue	1,511	163	1.13	602	95	1.19
SB I-680 off-ramp to Treat Boulevard/ Sunnyvale Avenue	3,007	489	1.19	1,017	205	1.24
SB I-60 on-ramp from Treat Boulevard/ Sunnyvale Avenue	3,049	436	1.19	1,156	188	1.22
SB I-680 on-ramp from Treat Boulevard	630	81	1.15	213	27	1.15
SB I-680 off-ramp to N. Main Street	3,327	551	1.21	1,280	213	1.21
SB I-680 on-ramp from Ygnacio Valley Road	3,265	314	1.12	1,232	126	1.13

Source: DKS Associates, 2008
Note: Assumed average of 3.5 persons per vehicle for 3+ person vehicles

3.4.3 Freeway Travel Time/Speed Profiles

AM and PM peak period tach run data were provided by Caltrans and MTC. This information was originally compiled as part of MTC's I-680 North Corridor Freeway Performance Initiative Study. These data were collected in 2006.

3.4.4 Intersection Turning Movement Counts

The City of Walnut Creek provided AM and PM peak hour turning movement counts for seven intersections, as shown in **Figure 3-5**, in the vicinity of the Pleasant Hill and Walnut Creek BART stations. To supplement these data, DKS collected turning movement counts at six intersections, also shown in Figure 3-5. These data were entered into Synchro, along with signal timing plans, to generate existing LOS at these intersections. These results are presented in **Table 3-9**.

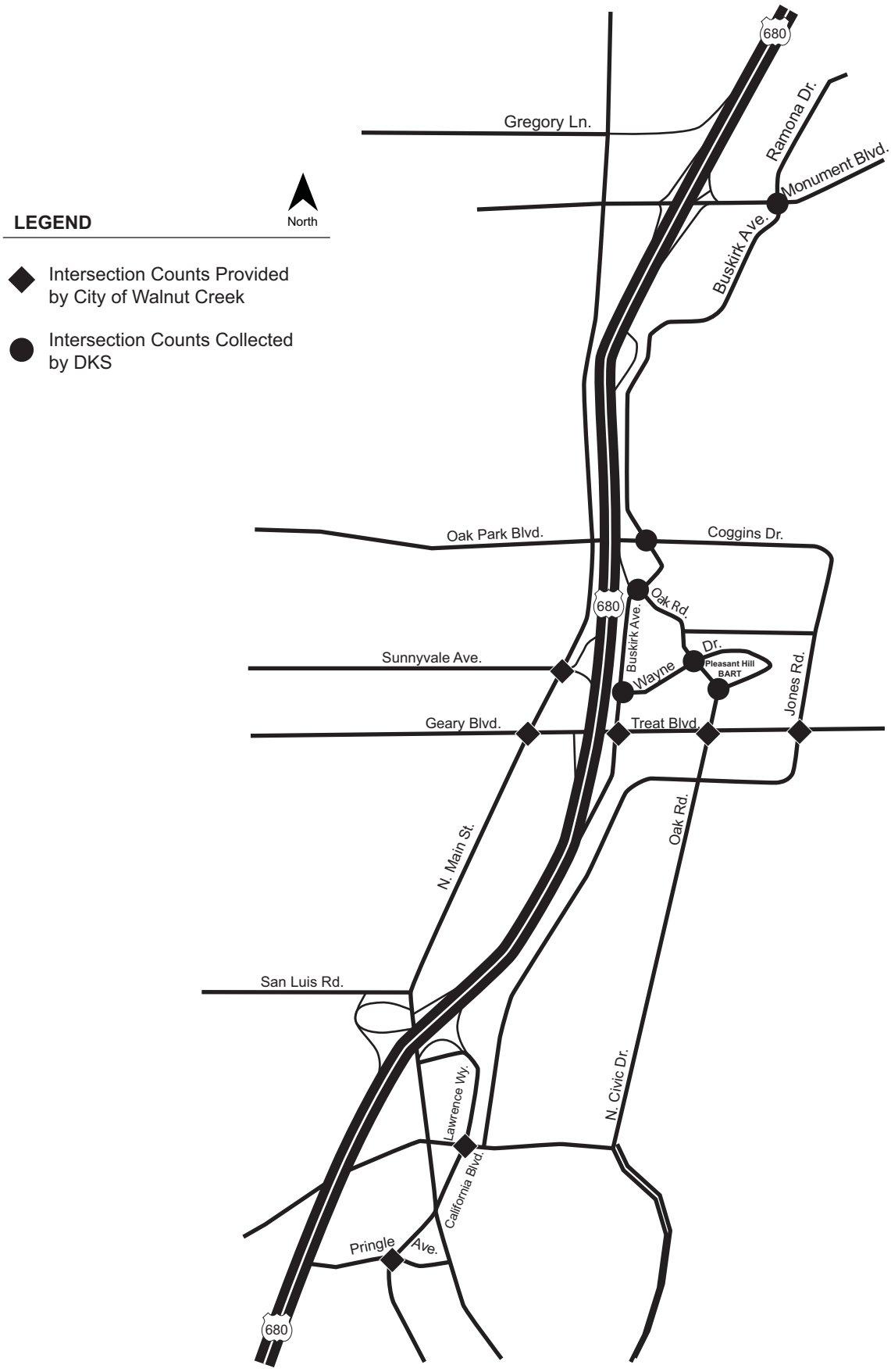


FIGURE 3-5
Study Intersections
I-680 HOV/Express Bus Access Study

Source: DKS Associates, 09/2008.

TABLE 3-9
Intersection Level of Service

Intersection Turning Movement Counts	Source	AM Peak Hour (7:30 AM - 8:30 AM)		PM Peak Hour (5:00 PM - 6:00 PM)	
		V/C	LOS	V/C	LOS
N. Main St/Sunnyvale Ave-SB ramps	City of Walnut Creek	0.85	D	0.87	D
N. Main St/Treat Blvd		0.80	C	0.76	C
Buskirk-Ave NB ramps/Treat Blvd		0.74	B	0.69	B
Oak Rd/Treat Blvd		0.76	D	0.87	D
Jones Rd/Treat Blvd		0.89	D	1.07	E
N Main St/California Blvd-Lawrence Way		0.44	A	0.45	B
California/Pringle Ave		0.39	A	0.41	C
Buskirk Ave/Oak Rd	DKS	0.56	A	0.61	B
Buskirk Ave/Wayne Ct		0.30	A	0.53	A
Oak Rd/Wayne Ct-BART entrance		0.26	A	0.33	A
Oak Rd/BART entrance		0.28	A	0.44	A
Buskirk Ave/Coggins Dr		0.54	A	0.43	A
Buskirk Ave/Monument Blvd		0.71	C	0.77	C

Notes:
LOS = Level of Service; V/C = vehicle count

Source: DKS Associates, 2008

3.5 Existing Traffic Operating Conditions

This section provides a discussion of the existing congestion patterns within the study area, focusing on I-680. This discussion includes the identification of areas of recurring congestion, bottleneck locations, and the causes of congestion.

3.5.1 AM Peak

3.5.1.1 I-680 Freeway

There are two distinct I-680 segments in the study area that were observed to experience congestion during the AM Peak period: one in the northbound direction, and one in the southbound direction.

Northbound

A. South of the Treat Boulevard interchange is an area of moderate congestion. Factors contributing to this congestion include:

- A high-volume weave area between North Main Street and Treat Boulevard;
- An exit to the truck scale; and
- Auxiliary lane ends at Treat Boulevard.

Southbound

B. Moderate to severe congestion occurs throughout the central portion of the corridor from the SR 242 interchange south to north of SR 24. This segment includes the SR 24 interchange as well as a number of high-volume service (local arterial) interchanges. Possible sources of this congestion include:

- Heavy lane changing between the SR 242 and SR 24 interchanges with large volumes of traffic in between; and
- A lane drop at Treat Boulevard.

3.5.1.2 Arterial Roads

In the vicinity of the Pleasant Hill BART Station, the arterial roads are North Main Street and Treat Boulevard, which becomes Geary Road west of North Main Street. On North Main Street, the peak traffic directions are southbound during the AM peak and northbound during the PM peak. There is a heavy left turn movement onto southbound North Main Street at the southbound off-ramp adjacent to the truck scales. This movement generally does not clear the queue during each cycle in the AM peak and the block between the ramp and Treat Boulevard/Geary Road intersection fills each cycle. The left turn bay into Treat Boulevard is relatively short and generally overflows. This means that some left-turning vehicles are trapped in the through lane queue, and occasionally the left-turn queue blocks through traffic.

These two left turns (off-ramps for North Main Street and Treat Boulevard) provide the primary route to the BART station for vehicles on southbound I-680. This movement also serves traffic destined for the office buildings and businesses to the north and south of Treat Boulevard adjacent to Oak Road. Jones Road provides the primary entrance to BART parking from both directions on Treat Boulevard.

Treat Boulevard is an arterial road of regional significance and provides an important arterial road function connecting parts of Concord, Walnut Creek and Clayton to I-680, and also provides a route to/from Bay Point via Bailey Road. Several bus routes use all or part of Treat Boulevard to and from the BART station. During the AM peak, there is significant congestion on Treat Boulevard between Bancroft Road and North Main Street. The key intersections of Oak Road, I-680 northbound off ramp and Buskirk Avenue, and North Main Street have heavy turning movements and long pedestrian crossing times. It often takes several cycles for westbound traffic to clear the Oak Road intersection, and westbound queues often extend beyond Cherry Lane.

Some congestion is observed on northbound Buskirk at Monument in the AM peak.

In the vicinity of Walnut Creek BART station, the primary arterial road is Ygnacio Valley Road. It is an arterial road of regional significance. Ygnacio Valley Road experiences significant congestion during the AM peak, although there is excellent coordination of the signals. The volume of traffic reaching the intersections near the BART station is largely

constrained by the capacity of Ygnacio Valley Road to the west, particularly at the intersections of North Main Street and Civic Drive. Therefore the signals in the vicinity of the BART station operate satisfactorily.

3.5.2 PM Peak

3.5.2.1 I-680 Freeway

Three distinct I-680 segments in the study area were observed to experience congestion during the PM Peak period: two in the northbound direction, and one in the southbound direction.

Northbound

A. Varying levels of congestion occurs throughout the segment from Alcosta Boulevard to Treat Boulevard. This segment of freeway progresses from mild congestion south of Crow Canyon Road, to moderate congestion south of Diablo Road, to severe congestion from Diablo Road to Treat Boulevard. Contributing factors include:

   - A heavy weave area between North Main Street and Treat Boulevard;
   - An exit to the truck scale at Treat Boulevard;
   - The auxiliary lane ending at Treat Boulevard;
   - A high number of lane changes before and after the SR 24 interchange, which enters I-680 from the left side;
   - Closely-spaced interchanges between Stone Valley Road and Sycamore Valley Road with short weaving sections;
   - Lane changing associated with the start of the HOV lane at Alcosta Boulevard; and
   - Short merging area at Alcosta Boulevard.

B. The second congested segment occurs south of the SR 4 interchange. Possible causes include:

   - The I-680/SR 4 interchange geometry (a cloverleaf interchange on a collector-distributor road);
   - Relatively high exiting volume SR 4; and
   - The geometry of the Burnett Avenue on-ramp, including a sort merge and horizontal curve.

The soon-to-be-opened new northbound span and toll plaza may greatly reduce the level of congestion on this segment.

Southbound

C. Moderate to severe congestion occurs within central Contra Costa starting on SR 24 west of Pleasant Hill Road, through the I-680 interchange, and south to the Sycamore Valley Road interchange. Contributing factors to the congestion are:

- Lane drop at low-volume Livorna Road off-ramp; and
- Closely spaced intersections with short weaving sections between Stone Valley Road and Sycamore Valley Road.

3.5.2.2 Arterial Roads

In the vicinity of the Pleasant Hill BART station, the predominant traffic flows during the PM peak are northbound on North Main Street and eastbound on Treat Boulevard. The most congested intersections are North Main Street/Treat Boulevard/Geary Road and Treat Boulevard/Oak Road. Jones Road and Oak Road provide the main routes to Treat Boulevard from the BART parking structures. During the height of the peak, congestion on Treat Boulevard fills the blocks between Jones Road and North Main Street. Buses traveling from North Main Street to BART via Jones Road experience delays at each intersection.

Some queuing is observed for the left turn movement at the entrance to the I-680 northbound ramp on Oak Road/Buskirk Road. Some drivers leaving BART and the adjacent businesses prefer to travel via Oak and Treat then turn right onto Buskirk Road to access I-680 via the Buskirk Road on-ramp, rather than travel north on Oak Road to the other off-ramp.

Little congestion is observed on Coggins or the northern end of Buskirk Road during the PM peak. There is some delay on Buskirk Road at the four-way stop at Elmira Lane and the shopping center driveway. Congestion on Monument sometimes blocks the Buskirk Road/ Monument Boulevard intersection, contributing to delays on northbound Monument Boulevard.

In the vicinity of Walnut Creek BART, the predominant traffic movement is eastbound on Ygnacio Valley Road, with the bulk of the traffic turning right from the I-680 northbound off-ramp. In spite of the coordination, most traffic experiences several stops in this area and occasionally eastbound queues do not clear in a single cycle. There are long pedestrian walk and clearance times at all the Ygnacio Valley Road intersections to the east of I-680. While there is substantial traffic heading north out of Walnut Creek's downtown and business core, those streets are accommodated by the signal timing. Traffic traveling west on Ygnacio Valley Road is heavy and occasional cycles do not clear the queues.

3.6 Origin/Destination Patterns

The projected 2010 and 2030 AM peak period origin/destination patterns for transit trips, HOV trips, and total person trips were derived from the CCTA Countywide Travel Forecasting Model. **Tables 3-10** to **3-13** show the projected origin/destination patterns between the five MTC Superdistricts in Contra Costa County (Superdistricts 20 through 24, as shown in **Figure 3-6**) and the surrounding sub-areas. Because the transit trips are person trips, all trip ends reported are in person trips.

As shown in **Table 3-10** and **Table 3-12**, during the AM peak period in 2010, around 80 percent of the HOV trips from central Contra Costa County have a destination inside Contra Costa County, mainly in the central county, the Tri-Valley, and the east county areas. About 3 percent of the HOV trips originating from the central Contra Costa County will go to

TABLE 3-10
AM Peak Period Person Trip Origin/Destination Pattern in Year 2010 (Origin from Contra Costa County)

Superdistrict/ Subarea Destination	Total	Contra Costa County Superdistrict					San Francisco County	San Mateo County	Santa Clara County	Alameda County – N/O I-580	Alameda County – S/O I-580	Solano/ Napa County	Sonoma County	External Trips Fr NE (e.g. Sacramento)
		20	21	22	23	24								
Origin - Superdistrict 20 (West County)														
HOV	26,545	17,613	618	305	185	65	1,689	220	169	320	2,866	1,562	897	37
Transit	13,518	2,496	151	65	33	3	6,847	158	38	60	3,436	86	145	0
Total	127,285	71,399	5,326	2,328	791	609	12,366	1,592	766	2,354	19,512	6,501	3,740	196
Origin - Superdistrict 21 (East/Central County)														
HOV	28,349	552	17,396	3,091	822	1,434	1,764	298	396	453	989	943	189	24
Transit	8,298	146	1,366	495	230	41	4,834	94	19	161	846	57	10	0
Total	146,147	2,914	82,338	19,576	5,501	7,290	9,813	1,811	1,286	3,311	6,562	4,819	924	179
Origin - Superdistrict 22 (Central County)														
HOV	15,996	256	2,781	7,792	1,046	240	1,727	160	270	330	1,137	174	82	2
Transit	6,117	23	160	439	140	4	4,212	49	16	83	978	10	3	0
Total	85,260	1,485	15,051	39,891	5,333	990	8,651	996	876	2,422	7,718	1,340	507	54
Origin - Superdistrict 23 (Tri-Valley)														
HOV	15,475	114	783	2,095	8,562	117	537	208	438	1,861	633	78	38	9
Transit	3,604	1	31	98	228	0	1,791	84	373	479	516	0	0	0
Total	82,700	745	5,406	9,366	40,931	535	3,778	1,370	2,678	12,633	4,449	528	281	84
Origin - Superdistrict 24 (East County)														
HOV	32,259	578	4,620	1,047	741	20,811	1,412	271	231	887	896	535	203	26
Transit	7,281	16	867	382	234	1,823	3,175	83	28	148	507	17	2	0
Total	146,481	1,774	21,270	5,313	2,855	89,419	6,447	1,672	1,276	6,275	6,158	3,153	871	178
Origin - Contra Costa County Total														
HOV	118,622	19,112	26,198	14,330	11,356	22,668	7,129	1,156	1,504	2,458	7,913	3,292	1,409	97
Transit	38,819	2,682	2,576	1,480	865	1,872	20,858	468	473	777	6,437	170	160	0
Total	588,563	78,317	129,391	76,474	55,411	98,842	41,055	7,441	6,882	18,238	53,158	16,340	6,324	690

Notes: N/O = north of; S/O = south of
Source: DKS Associates, 2008

TABLE 3-11
AM Peak Period Person Trip Origin/Destination Pattern in Year 2010 (Destination to Contra Costa County)

Superdistrict/ Subarea Destination	Total	Contra Costa County Superdistrict					San Francisco County	San Mateo County	Santa Clara County	Alameda County – N/O I-580	Alameda County – S/O I-580	Solano/ Napa County	Sonoma County	External Trips Fr NE (e.g. Sacramento)
		20	21	22	23	24								
Destination - Superdistrict 20 (West County)														
HOV	23,957	17,613	552	256	114	578	335	151	513	435	2,195	1,024	161	31
Transit	4,024	2,496	146	23	1	16	186	37	0	77	994	36	13	0
Total	99,235	71,399	2,914	1,485	745	1,774	1,323	590	1,090	2,133	9,645	4,798	1,139	199
Destination - Superdistrict 21 (East/Central County)														
HOV	30,589	618	17,396	2,781	783	4,620	212	133	1,365	493	645	1,417	82	43
Transit	3,313	151	1,366	160	31	867	129	25	4	136	244	197	2	0
Total	149,238	5,326	82,338	15,051	5,406	21,270	961	536	2,991	3,121	3,955	7,660	438	186
Destination - Superdistrict 22 (Central County)														
HOV	17,240	305	3,091	7,792	2,095	1,047	209	117	942	550	672	325	58	39
Transit	2,419	65	495	439	98	382	181	36	10	213	441	45	12	0
Total	88,903	2,328	19,576	39,891	9,366	5,313	940	422	1,999	3,016	3,714	1,834	351	152
Destination - Superdistrict 23 (Tri-Valley)														
HOV	14,508	185	822	1,046	8,562	741	69	68	590	1,929	306	140	24	25
Transit	1,985	33	230	140	228	234	97	82	12	748	170	5	6	0
Total	70,996	791	5,501	5,333	40,931	2,855	436	440	1,729	9,773	2,078	868	183	76
Destination - Superdistrict 24 (East County)														
HOV	23,291	65	1,434	240	117	20,811	54	27	172	153	55	133	16	12
Transit	1,888	3	41	4	0	1,823	7	0	0	2	6	2	0	0
Total	101,929	609	7,290	990	535	89,419	214	108	397	775	349	1,033	111	99
Destination - Contra Costa County Total														
HOV	109,585	18,786	23,294	12,114	11,672	27,797	879	495	3,582	3,560	3,874	3,041	341	149
Transit	13,630	2,748	2,279	766	359	3,323	600	179	26	1,175	1,855	285	33	0
Total	510,300	80,452	117,620	62,749	56,983	120,631	3,874	2,096	8,207	18,817	19,743	16,194	2,221	0

Notes: N/O = north of; S/O = south of
Source: DKS Associates, 2008

TABLE 3-12
AM Peak Period Person Trip Origin/Destination Pattern in Year 2030 (Origin from Contra Costa County)

Superdistrict/ Subarea Destination	Total	Contra Costa County Superdistrict					San Francisco County	San Mateo County	Santa Clara County	Alameda County – N/O I-580	Alameda County – S/O I-580	Solano/ Napa County	Sonoma County	External Trips Fr NE (e.g. Sacramento)
		20	21	22	23	24								
Origin - Superdistrict 20 (West County)														
HOV	31,033	20,353	806	360	268	92	2,233	280	185	456	3,240	1,872	777	110
Transit	17,395	2,954	185	91	66	5	9,449	361	186	146	3,716	28	207	
Total	150,768	82,456	6,357	2,680	1,027	908	16,744	2,161	1,003	3,258	21,791	8,041	3,754	588
Origin - Superdistrict 21 (East/Central County)														
HOV	36,590	840	21,472	3,628	1,430	2,260	2,494	416	451	778	1,302	1,255	193	71
Transit	12,696	188	1,743	567	395	212	7,698	301	125	350	1,096	8	14	
Total	189,002	3,939	101,787	22,172	7,390	13,328	14,429	2,649	1,645	5,209	8,440	6,494	983	537
Origin - Superdistrict 22 (Central County)														
HOV	19,012	354	3,251	8,622	1,341	365	2,328	215	289	489	1,426	243	83	6
Transit	9,541	40	233	601	243	15	6,581	155	106	192	1,369	0	5	
Total	101,358	1,944	17,336	43,557	6,483	1,383	12,354	1,438	1,123	3,498	9,749	1,790	540	161
Origin - Superdistrict 23 (Tri-Valley)														
HOV	22,861	200	1,028	2,288	12,318	209	936	395	802	3,502	969	127	57	28
Transit	7,591	3	61	188	639	3	3,167	268	1,010	1,478	771	0	1	
Total	115,052	1,077	6,691	10,691	53,457	842	6,251	2,392	4,803	21,237	6,215	794	350	252
Origin - Superdistrict 24 (East County)														
HOV	40,469	714	5,048	1,089	1,044	26,916	1,645	326	336	2,012	595	537	129	77
Transit	9,921	21	1,062	384	343	3,157	3,798	201	132	325	493	1	4	
Total	194,018	1,967	24,922	5,300	3,353	125,334	7,612	2,083	1,764	12,533	4,143	3,732	742	532
Origin - Contra Costa County Total														
HOV	149,965	22,462	31,605	15,988	16,402	29,842	9,636	1,633	2,063	7,236	7,533	4,036	1,239	292
Transit	57,143	3,206	3,284	1,832	1,686	3,392	30,693	1,285	1,561	2,491	7,445	37	231	0
Total	750,197	91,383	157,093	84,398	71,710	141,795	57,391	10,724	10,338	45,735	50,337	20,852	6,369	2,071

Notes: N/O = north of; S/O = south of
Source: DKS Associates, 2008

TABLE 3-13
AM Peak Period Person Trip Origin/Destination Pattern in Year 2030 (Destination to Contra Costa County)

Superdistrict/ Subarea Destination	Total	Contra Costa County Superdistrict					San Francisco County	San Mateo County	Santa Clara County	Alameda County – N/O I-580	Alameda County – S/O I-580	Solano/ Napa County	Sonoma County	External Trips Fr NE (e.g. Sacramento)
		20	21	22	23	24								
Destination - Superdistrict 20 (West County)														
HOV	27,971	20,353	840	354	200	714	320	122	425	435	2,531	1,379	206	92
Transit	5,050	2,954	188	40	3	21	119	45	16	112	1,502	36	14	
Total	117,309	82,456	3,939	1,944	1,077	1,967	1,353	589	923	2,397	11,932	6,485	1,651	596
Destination - Superdistrict 21 (East/Central County)														
HOV	36,811	806	21,472	3,251	1,028	5,048	246	114	1,308	515	906	1,915	73	130
Transit	4,153	185	1,743	233	61	1,062	128	37	16	153	296	236	3	
Total	180,376	6,357	101,787	17,336	6,691	24,922	1,082	535	2,846	3,221	4,876	9,674	491	558
Destination - Superdistrict 22 (Central County)														
HOV	19,075	360	3,628	8,622	2,288	1,089	209	91	868	519	803	422	60	116
Transit	3,190	91	567	601	188	384	230	56	36	261	709	43	22	
Total	98,059	2,680	22,172	43,557	10,691	5,300	1,020	390	1,865	2,956	4,369	2,183	420	457
Destination - Superdistrict 23 (Tri-Valley)														
HOV	20,465	268	1,430	1,341	12,318	1,044	107	78	751	2,234	516	257	45	75
Transit	3,936	66	395	243	639	343	162	164	82	1,416	400	6	20	
Total	91,358	1,027	7,390	6,483	53,457	3,353	611	568	2,188	11,550	3,031	1,179	292	228
Destination - Superdistrict 24 (East County)														
HOV	31,051	92	2,260	365	209	26,916	79	41	355	250	108	317	23	36
Transit	3,434	5	212	15	3	3,157	11	4	0	4	19	3	0	
Total	147,153	908	13,328	1,383	842	125,334	302	155	752	1,191	589	1,901	170	298
Destination - Contra Costa County Total														
HOV	135,373	21,880	29,630	13,934	16,044	34,811	961	445	3,706	3,953	4,864	4,291	408	448
Transit	19,764	3,302	3,104	1,132	895	4,967	651	305	151	1,947	2,927	325	60	0
Total	634,255	93,427	148,616	70,704	72,757	160,876	4,368	2,239	8,573	21,315	24,798	21,421	3,025	2,136

Notes: N/O = north of; S/O = south of
Source: DKS Associates, 2008

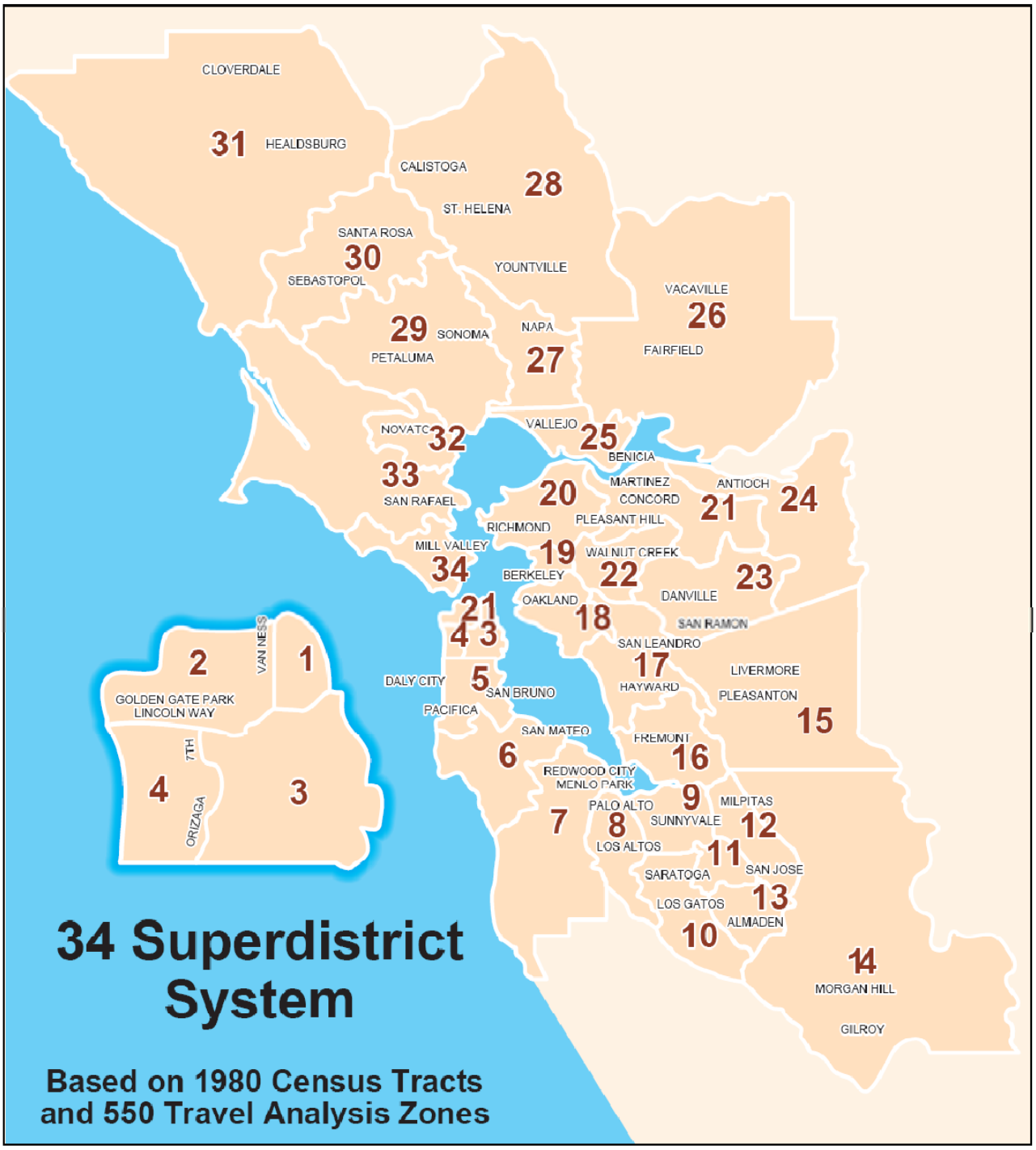


FIGURE 3-6
MTC Superdistrict System

Solano/Napa County and further north. Around 8 percent will go to San Francisco through SR 24 and about 5 percent will go south to Alameda County south of I-580.

Transit trips follow a different pattern. During the AM peak period in 2010, only about 20 percent of central Contra Costa transit riders are expected to go to other locations inside Contra Costa County, mainly in the central county and the Tri-Valley areas. Also, less than 1 percent will go to Solano/Napa County and further north. However, about 60 percent of central Contra Costa County transit riders will go to San Francisco and about 15 percent will go to Alameda County south of I-580.

As shown in **Table 3-11** and **Table 3-13**, during the AM peak period in 2030, roughly 80 percent of the HOV trips going to the central Contra Costa County are projected to originate from Contra Costa County, mainly from the central county, the Tri-Valley and the east county areas. Around 3 percent of the HOV trips going to central Contra Costa County will originate from Solano/Napa County and further north. About 5 percent will be from Alameda County, mainly from the area south of I-580, and about 10 percent from San Francisco.

As in the 2010 projections, 2030 transit trips will follow a different pattern. During the AM peak period, only about 18 percent of transit riders going to central Contra Costa County will originate from inside of Contra Costa County, mainly from the central county and the Tri-Valley areas. Also, less than 1 percent will come from Solano/Napa County and further north. However, about 65 percent of transit riders going to the central Contra Costa County will be from San Francisco, and about 12 percent will be from Alameda County south of I-580.

4.0 Evaluation Criteria

The analysis for this study was conducted in two steps. The first step was to screen a wide range of potential alternatives. For this step, screening criteria were used to qualitatively screen alternatives for further quantitative analysis. The screening of RM 2 Investment Options was conducted separately and used different criteria from the screening for the Other Arterial and Freeway Improvements.

The second step was to prioritize those alternatives with a more detailed analysis, after the screening process. The same prioritization criteria were used for all options, were quantitative where measurable, and included qualitative measures. The RM 2 Investment Options were prioritized separately, and then also compared to the Other Arterial and Freeway Improvements in the prioritization process.

4.1 Screening

4.1.1 Screening Criteria

Screening criteria have been developed to screen the RM 2 Investment Options and the Other Arterial and Freeway Improvements. The criteria are based on information gathered from a review of existing studies and plans, a summary of current transit service, an initial assessment of future transit service, an overview of available data, and an assessment of likely stakeholder priorities in the corridor.

Because of the characteristics for each set of options, separate screening criteria were developed. In particular, the final screening criteria focused on those that differentiated between the options. For the RM 2 Investment Options, the following screening criteria were applied:

- **Regional Measure 2 Goals**: Does the option meet the goals as specified in RM 2?
- **HOV/Transit System Access and Connectivity**: Does the option improve or degrade connectivity with the regional HOV and transit systems?
- **Traffic Operations**: Does the option improve or degrade traffic operations on I-680 and the study area arterials? Does the option eliminate or reduce the queues and weaving on I-680? Does the option increase or decrease the delay at intersections? Will the option improve the operations of the existing HOV lanes?
- **Constructibility**: Is the option constructible? Can it be built without undue impacts on the existing transportation network and on the local jurisdictions?
- **Cost**: Is the cost of the option consistent with funding realities in the region? Cost includes the capital construction, right-of-way and project development costs.

For the Other Arterial and Freeway Improvements, the following screening criteria were applied:

- **HOV/Transit System Access and Connectivity**: Does the option improve or degrade connectivity with the regional HOV and transit systems?
- **Traffic Operations**: Does the option improve or degrade traffic operations on I-680 and the study area arterials? Does the option eliminate or reduce the queues and weaving on I-680? Does the option increase or decrease the delay at intersections? Will the option improve the operations of the existing HOV lanes?
- **Safety**: Does the option have a potential impact on safety? Does the option increase or decrease the volume of weaving traffic and the number of lane changes on freeway? Does the option increase or decrease the potential traffic conflicts on the surface streets?
- **Environmental Constraints**: Will the option result in significant (potentially unmitigable) environmental impacts?
- **Planning Consistency**: Does the option fit in with other planned projects in the I-680 corridor?
- **Constructibility**: Is the option constructible? Can it be built without undue impacts on the existing transportation network and on the local jurisdictions?
- **Cost**: Is the cost of the option consistent with funding realities in the region? Cost includes the capital construction, right-of-way and project development costs.

4.1.2 Measurement of Screening Criteria

Potential alternative options were assessed using the following scale for each screening criterion:

●● Significant benefit (two solid green circles)

● Measurable benefit (one solid green circle)

◉ Neutral (blue bullseye)

○ Measurable disbenefit (one open black circle)

○○ Significant disbenefit (two open black circles)

× Fatal flaw (red "x")

Note that while the screening process used available data and engineering judgment, the application of the screening criteria was primarily qualitative. **Table 4-1** provides a listing of a generic interpretation of the assessments (benefits or disbenefits) for the evaluation criteria.

TABLE 4-1
Interpretation of Screening Evaluation Criteria

Evaluation Criterion	Assessment		
	Benefit	**Disbenefit**	**Fatal Flaw**
Regional Measure 2 Goals	Meets the goals as described in the RM 2 legislation.	Does not meet the goals as described in the RM 2 legislation.	Specific, significant conflicts that may preclude projects that meet RM 2 goals
HOV/Transit System Access and Connectivity	Increases access to, and connectivity with, existing and future HOV/transit facilities.	Reduces access to, and connectivity with, existing and future HOV/transit facilities.	Prevents future development of HOV/transit facilities identified in the Regional HOV Plan and/or transit plans.
Traffic Operations	Improves (decreases) travel time on mainline freeway sections and delay at study intersections.	Increases travel time on mainline freeway or delay at study intersections.	Creates new bottlenecks with greater severity of delay than the previous bottlenecks. Significant increase in intersection delay.
Safety	Improves safety by decreasing the volume of weaving and number of lane changes on the freeway and/or reduces the potential traffic conflicts on surface streets.	Degrades safety by increasing the volume of weaving or number of lane changes and/or increases the potential traffic conflicts on surface streets.	Creates new safety problems by increasing the volume of weaving and number of lane changes and/or by creating significant new traffic conflicts on surface streets.
Environmental Constraints	Minimal impacts or constraints related to environmental elements.	Significant environmental constraints that require somewhat higher construction costs.	Environmental constraints that require much higher construction costs.
Planning Consistency	Logical extension of other projects planned in the I-680 corridor.	May conflict and/or overlap with other planned projects.	Specific, significant conflicts that may preclude other projects.
Constructibility	Buildable with minimal impacts to existing traffic, as well as minimal traffic and noise impacts on local jurisdictions.	Constructing the project without significant impacts would substantially increase project cost.	Cannot be built without extended, significant impacts to existing traffic and to local jurisdictions.
Cost	Manageable cost and good cost-benefit ratio.	High cost or low cost-benefit ratio.	Very high cost.

4.2 Prioritization Criteria

Each of the options were evaluated and ranked in order of priority based on a wide range of prioritization criteria that were developed in coordination with the Study TAC and PAC. Many of the screening evaluation criteria were carried forward to the prioritization process. Other criteria (e.g., transit operations) are only applied for prioritization.

The prioritization criteria are both quantitative and qualitative, and are briefly described below.

- **HOV/Transit System Access and Connectivity** (qualitative) – extent to which the option would increase access to, and connectivity with, existing and future HOV/transit facilities.
- **Transit Operations** (qualitative) – extent to which the option would ease transfers between routes and modes. Also includes an assessment as to whether the option would result in more efficient operations for the transit operators.
- **Traffic Operations** (quantitative) – potential impact to roadway operations. Performance measures assessed for the Regional Measures 2 Investment Options, which are freeway-based strategies, included hours of delay, HOV/Bus travel time, mode shift, and freeway operations (weaving). Performance measures assessed for the arterial-based strategies included HOV/Bus travel time and intersection delay.
- **Environmental Impacts** (qualitative) – potential impact on the natural and built environment. The assessment was based on existing information and a "windshield survey" of the corridor; no field studies or original analyses was performed. This assessment considered several factors including potential impacts to air quality, noise, natural resources, and aesthetics.
- **Right-of-Way Impacts** (quantitative) – number of parcels potentially impacted. For this level of evaluation, full versus partial takes were not differentiated.
- **Capital Cost** (quantitative) - order-of-magnitude capital cost estimates in current (2009) dollars. Right-of-way costs are not included in this cost estimate.

The evaluation was conducted both with and without the consideration of the estimated capital costs for each option.

Performance measures for each evaluation criteria are listed in **Table 4-2**. Any qualitative assessments were reported using a constructed "1 to 5" scale to allow for a comparison with the quantitative measures.

TABLE 4-2
Example Performance Measures for Prioritization

Evaluation Criterion	Performance Measure(s)	Comments
HOV/Transit System Access & Connectivity	• Improved HOV connectivity • Improved transit connectivity	Qualitative assessment
Transit Operations	• Ease of transferring between routes and modes • Impact on transit operator efficiency	Qualitative assessment
Traffic Operations	• Freeway mainline vehicle hours of delay • Freeway weaving • HOV/bus travel time • Average intersection delay	
Environmental Impacts	• Impacts on air quality, noise, natural resources	Qualitative assessment, comparison of impacts between alternatives
Right-of-Way Impacts	• Number of parcels potentially impacted	
Cost	• Project costs	Order of magnitude cost

5.0 Preliminary Options Identified

Before detailed evaluations were conducted in this study, preliminary options were identified and screened to determine the more feasible options. The preliminary options included specific HOV lane and HOV direct connector ramp improvements as defined in Regional Measure 2. Preliminary options were also identified for the Other Arterial and Freeway Improvements that could enhance transit and HOV access between I-680 and the Walnut Creek and Pleasant Hill BART Stations. A brainstorming session was held on June 27, 2008 with the Study TAC and CH2M HILL team members to cast a wide net for preliminary options.

Once a concept was developed and sketched for each preliminary option, the screening criteria described in Section 4 of this report were applied. The screening criteria were applied separately for the HOV Direct Ramp Options and the Other Arterial and Freeway Improvement Options. The culmination of the screening was the recommendation of options to be evaluated in more detail. Screening did not need to be conducted for the Southbound I-680 HOV Lane Gap Closure Project, which is described below.

5.1 Southbound I-680 HOV Lane Gap Closure Project

This project is included in the Regional Transportation Plan, and proposes to close the existing gap in the southbound I-680 HOV lane from the North Main Street interchange, through the SR 24 interchange and to the Livorna Road interchange. The boundaries of this project are illustrated in **Figure 5-1**. The information used in this evaluation was taken from the Draft Project Study Report (Project Development Support) (PSR /[PDS]) dated March 2009 for the Southbound I-680 HOV Lane Gap Closure project (Caltrans, 2009).

According to the Draft PSR, two "build" alternatives are being evaluated. Alternative 1 would widen the existing roadway to add a median HOV lane from north of Livorna Road to south of the Lilac Drive undercrossing, and re-stripe the existing roadway to continue the HOV lane to north of North Main Street, without any right-of-way acquisitions. This would require reducing the widths of the left shoulder as well as some of the inside lanes to below current Caltrans standards. The estimated capital cost of Alternative 1 in the Draft PSR was approximately $80 million.

Alternative 2 would widen the existing freeway throughout the project limits so that the proposed geometrics design would meet the current standards. This would require replacement of the BART overcrossing, Trinity Avenue overcrossing, and North Main Street overcrossing; widening of the South Main Street undercrossing, Las Trampas Creek Bridge, Ygnacio Valley Road undercrossing, Parkside Drive undercrossing, and Contra Costa Canal Bridge structures; and acquisition of new right-of-way. The estimated capital cost of Alternative 2 was approximately $210 million.

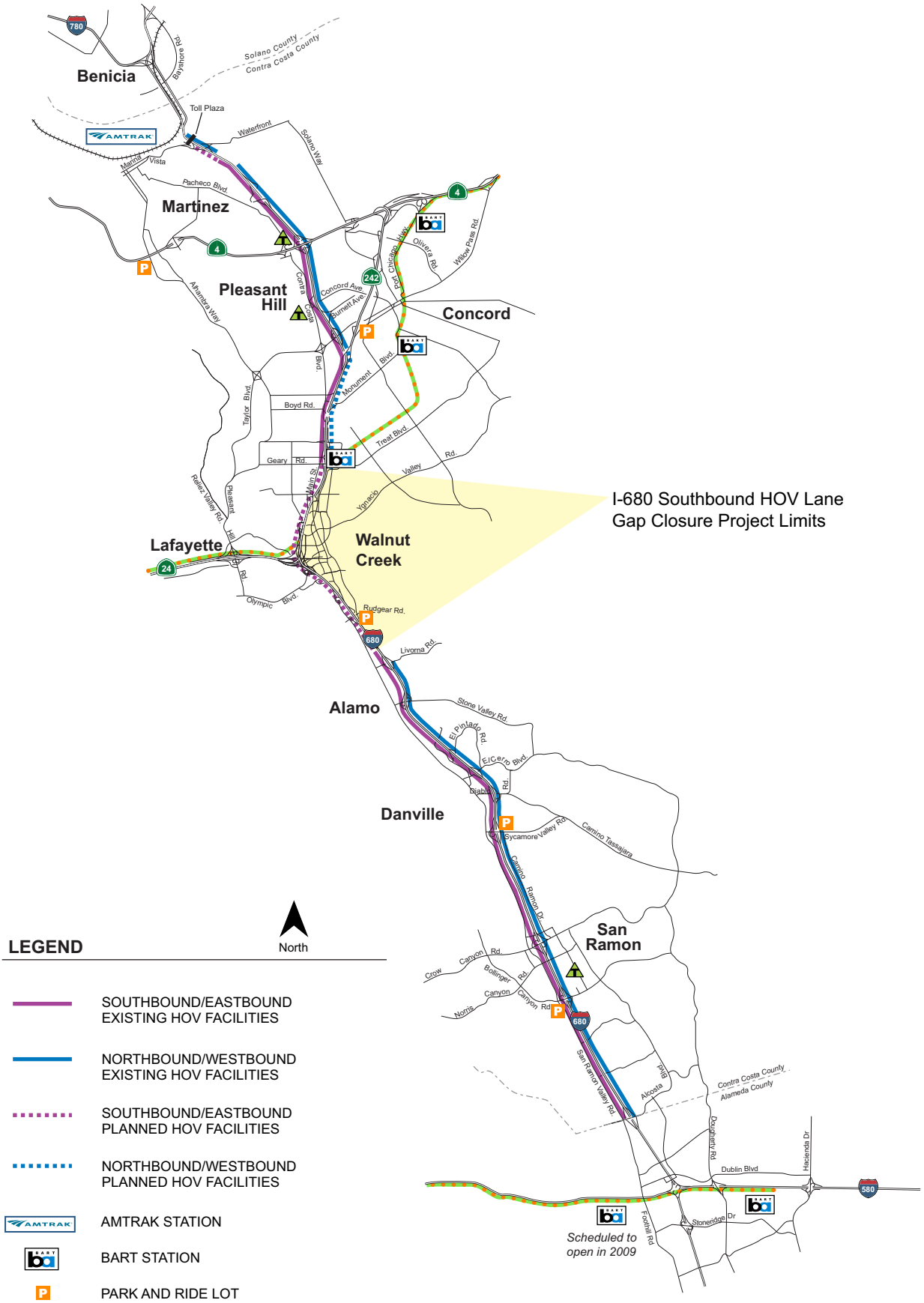


FIGURE 5-1
I-680 Southbound HOV Lane
Gap Closure Project Limits
I-680 HOV/Express Bus Access Study

Given the significant difference in cost between the two alternatives, and the much larger impact Alternative 2 would have on the BART overcrossing and many roadway structures, Alternative 1, as described in the Draft PSR, has the higher probability of being implemented for the Southbound I-680 HOV Lane Gap Closure project. (This conclusion is only for the purposes of evaluation within this I-680 HOV/Express Bus Access Study, and is not intended to influence the alternative selection process that is occurring independently for the Southbound I-680 HOV Lane Gap Closure project.) Therefore, Alternative 1 of the Southbound I-680 HOV Lane Gap Closure project was carried forward for evaluation in the present study.

5.2 HOV Direct Connector Ramps

To improve the transit and HOV connectivity between I-680 and the Pleasant Hill and Walnut Creek BART Stations, CH2M HILL identified potential HOV direct access ramps to and from I-680. All of the proposed ramps would improve access for HOVs that are coming from and going to the north of the BART stations, i.e., from I-680 Southbound to either of the BART stations and from the BART station to I-680 Northbound.

In the development of HOV Direct Connector Ramp options, it was assumed that two future planned HOV lane projects on I-680 would be in place:

1. **Southbound I-680 HOV Lane Gap Closure Project.** This project was described above in Section 5.1. As explained previously, for the purposes of the present study, Alternative 1 was chosen as the base condition in the development of HOV Direct Connector Ramp options because it has the higher probability of being implemented.

2. **Northbound I-680 HOV Lane Project.** This project proposes to add an HOV lane on I-680 in the northbound direction from the North Main Street Overcrossing north to connect to an existing HOV lane that begins just north of the I-680/SR 242 interchange. According to the Final Project Study Report dated March 2007, two "build" alternatives were evaluated. Alternative 1 would re-stripe the existing roadway to add a median HOV lane from north of North Main Street to Monument Boulevard without any right-of-way acquisitions. This would require reducing the widths of the left shoulder as well as some of the inside lanes. Widening of the freeway would be included from north of Monument Boulevard to the I-680/SR 242 interchange. The estimated capital cost for Alternative 1 in the Final PSR was approximately $29 million. Alternative 2 would widen the freeway throughout the project limits to accommodate the additional HOV lane using the current highway design standards. This would require widening of Contra Costa Canal bridge and Monument Boulevard Undercrossing and replacement of the I-680/SR 242 Separation structure, modifying the truck weigh station, realignment of Buskirk Avenue, and right-of-way acquisition. The estimated capital cost for Alternative 2 in the Final PSR was approximately $129 million. Alternative 1 was chosen as the base condition in the development of HOV Direct Connector Ramp options because it has the higher probability of being implemented.

The conceptual layout sketches for the six potential HOV Direct Connector Ramp options (Options A through F, as described below) were developed using a combination of aerial photos, existing studies, and available as-built drawings. Ideas were incorporated from a brainstorming session involving TAC and CH2M HILL team members held on June 27,

2008. The current Caltrans HOV Guidelines were used in assessing the preliminary layout for each option.

For the purposes of this study, it was assumed that the planned Transit-Oriented Developments (TOD) at the Pleasant Hill and Walnut Creek BART Stations would be in place, including the planned locations for transit centers. All six potential options consist of HOV direct access ramps that provide access to and from the north, and that enter and exit the freeway from the left via the median HOV lane. Options A-D target buses and HOVs traveling to the Walnut Creek BART Station. Option E targets those traveling to the Pleasant Hill BART Station. Option F provides a direct connector ramp between the two BART stations, with circulation to both.

Potential options were investigated that provide access to and from the south. Express buses and HOVs traveling to the Pleasant Hill BART station primarily come from the north, and it is not anticipated that the demand from the south would warrant HOV direct connector ramps. There are many express buses and HOVs accessing the Walnut Creek BART Station from the south. However, it was determined that it would be prohibitively expensive to construct HOV direct connector ramps from the south due to the proximity of the BART overcrossing and the I-680/SR 24 interchange. In addition, no median HOV lane is planned in the foreseeable future in the northbound direction through the I-680/SR 24 interchange. Finally, access between the Walnut Creek BART Station and I-680 to the south is already quite direct, and an HOV direct connector ramp in this location would likely not offer a significant level of improvement.

The six potential HOV Direct Connector Ramp options are listed in **Table 5-1**. More information on each option is provided in the following pages.

TABLE 5-1
List of HOV Direct Connector Ramp Options

A.	To Top of Walnut Creek BART Parking Garage
B.	To Walnut Creek BART Perimeter Road
C.	To Ygnacio Valley Road
D.	To North Main Street
E.	To Coggins Drive/Oak Park Boulevard
F.	To a New Overcrossing Between Treat Boulevard and North Main Street

5.2.1 Option A: HOV Direct Connector Ramps to Top of Walnut Creek BART Parking Garage

This option, illustrated in **Figure 5-2**, would provide bus-only direct connector ramps to the top level of the existing parking structure located in the Walnut Creek BART Station. Buses traveling south on I-680 would exit the HOV lane via the new ramp that ascends to an L-shaped two-way stop-controlled intersection. Then the buses would turn left and cross over I-680 northbound lanes and arrive at the top level of the parking structure, via a

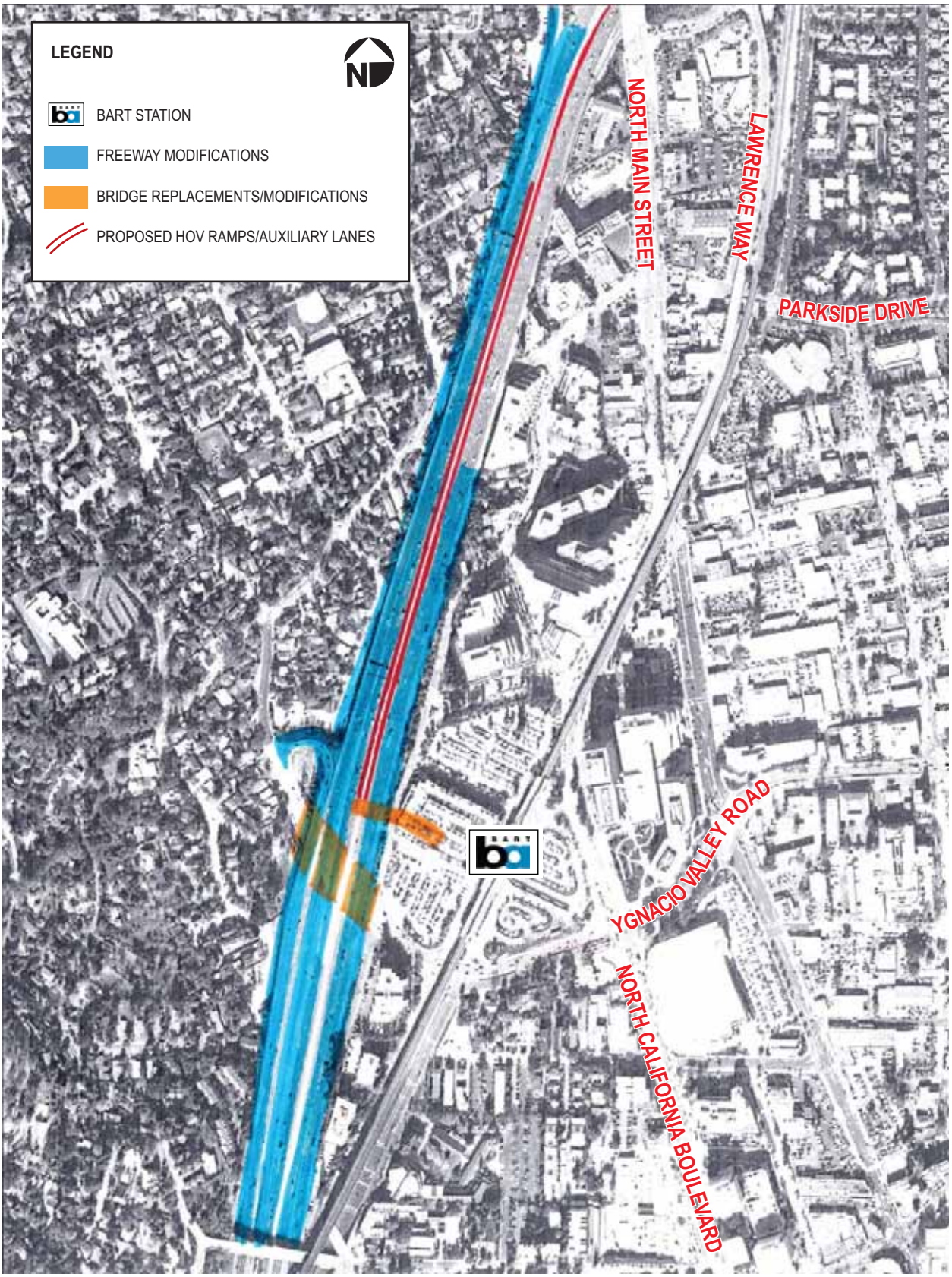


FIGURE 5-2
Option A: HOV Direct Connector Ramps to Top of Walnut Creek BART Parking Garage
I-680 HOV/Express Bus Access Study

freeway overcrossing and a viaduct structure. An additional level might need to be added to the parking structure as part of this option. However, this option would not significantly impact the planned TOD for the Walnut Creek BART Station. The buses accessing northbound I-680 would also use the structure over I-680 northbound and enter the freeway on the left side via the northbound direct on-ramp. Other associated work would include:

- Widening of I-680 to create the needed room in the median for the direct access ramps; this would require right-of-way acquisition mostly along the west side of I-680.
- Modifications to and widening of the three existing undercrossing structures at Ygnacio Valley Road.
- Relocation of the loop on-ramp from Ygnacio Valley Road to SR 24 westbound.
- Extension of the northbound HOV auxiliary lane beyond the minimally required length to meet the future northbound HOV lane that is planned to the north of the North Main Street Overcrossing.

Advantages:

- Buses would not need to weave from the HOV lane to the right exit across all lanes of traffic.
- Buses would reduce their travel on local streets in the vicinity of the Walnut Creek BART station, thereby reducing the travel time for those buses.
- A small reduction in vehicle traffic on the Lawrence Way northbound on-ramp to I-680, which is congested during the evening peak period, due to fewer buses using this on-ramp.

Disadvantages:

- Passengers would have to take the elevators or stairs to the ground level to access the BART station and bus terminals.
- Additions and modifications to the parking structure might not be feasible.
- Only one express bus (County Connection Route 980) currently accesses the Walnut Creek BART Station from I-680 southbound.
- Significant impacts to the residential area west of I-680.

5.2.2 Option B: HOV Direct Connector Ramps to Walnut Creek BART Perimeter Road

The HOV direct connector ramps in this option, illustrated in **Figure 5-3**, would serve both buses and HOVs traveling to the Walnut Creek BART Station. Buses and HOVs traveling south on I-680 would exit the HOV lane via the new ramp that descends to an at-grade intersection that would be an L-shaped two-way stop-controlled intersection. Then the buses would turn left and cross under I-680 northbound lanes and arrive at the perimeter road at the BART station via a freeway undercrossing structure. The buses and HOVs

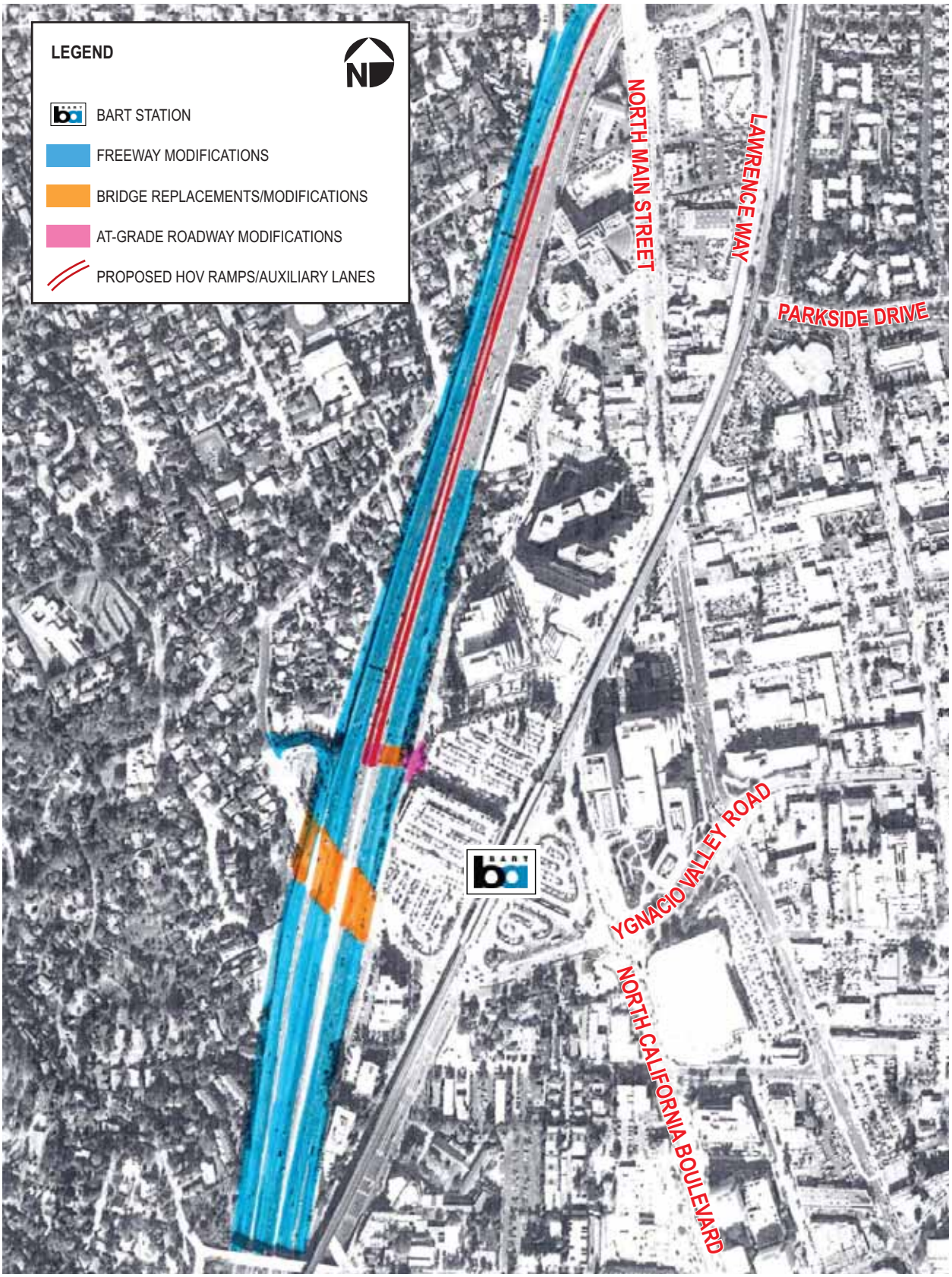


FIGURE 5-3
Option B: HOV Direct Connector Ramps to Walnut Creek Perimeter Road
I-680 HOV/Express Bus Access Study

accessing northbound I-680 would also use the structure under the I-680 northbound lanes and enter the freeway on the left side via the northbound direct on-ramp. This option would not significantly impact the planned TOD for the Walnut Creek BART Station. Other associated work is similar to that listed under Option A, and would include:

- Widening of I-680 to create the needed room in the median for the direct access ramps; this would require right-of-way acquisition mostly along the west side of I-680.
- Modifications to and widening of the three existing undercrossing structures at Ygnacio Valley Road.
- Relocation of the loop on-ramp from Ygnacio Valley Road to SR 24 westbound.
- Extension of the northbound HOV auxiliary lane beyond the minimally required length to meet the future northbound HOV lane that is planned to the north of the North Main Street Overcrossing.

Advantages:

- Buses and HOVs would not need to weave from the HOV lane to the right exit across all lanes of traffic.
- Buses and HOVs would reduce their travel on local streets in the vicinity of the Walnut Creek BART station, thereby reducing the travel time for those vehicles.
- Reduction in vehicle traffic on the Lawrence Way northbound on-ramp to I-680, which is congested during the evening peak period, due to fewer vehicles using this on-ramp.
- Direct access to the ground level of the Walnut Creek BART station, with easy access to both the planned transit center and the existing parking structure.

Disadvantages:

- Only one express bus (County Connection Route 980) currently accesses the Walnut Creek BART Station from I-680 southbound.
- Significant impacts to the residential area west of I-680.
- HOV direct ramps would primarily serve the BART station. Any HOVs with destinations elsewhere in downtown Walnut Creek would either be restricted from using this ramp, or would have to drive through the BART station to access the surface streets.

5.2.3 Option C: HOV Direct Connector Ramps to Ygnacio Valley Road

This option, illustrated in **Figure 5-4**, would provide HOV direct connector ramps to Ygnacio Valley Road, which is below I-680. HOVs traveling south on I-680 would exit the HOV lane via the new ramp that would descend to a new at-grade, signalized intersection at Ygnacio Valley Road. For those buses and HOVs traveling to the Walnut Creek BART Station, they would have to travel on the surface streets around the station, since vehicles traveling eastbound on Ygnacio Valley Road currently cannot turn left into the BART station. The buses and HOVs accessing northbound I-680 would also use the new Ygnacio -

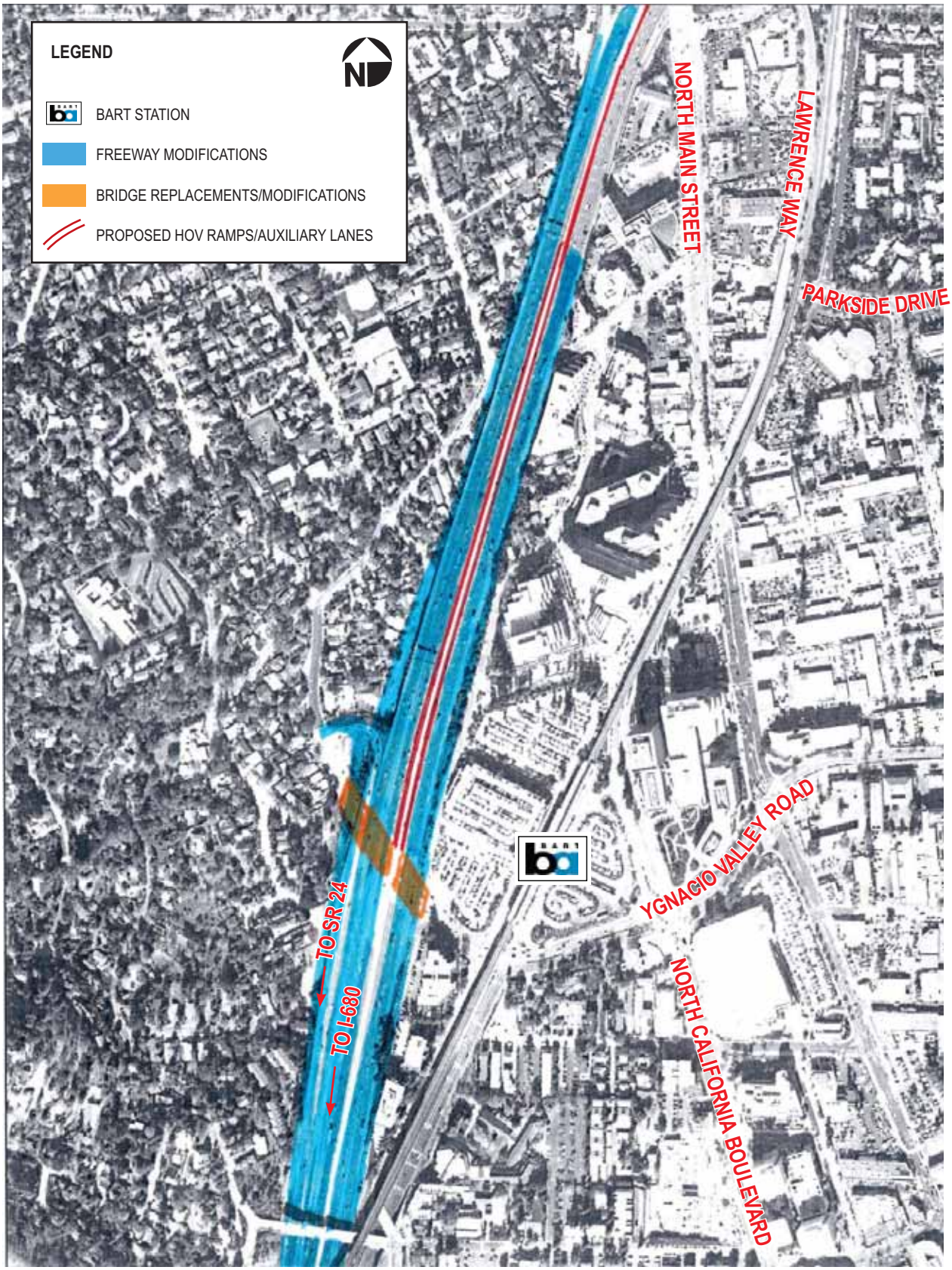


FIGURE 5-4
Option C: HOV Direct Connector Ramps to Ygnacio Valley Road
I-680 HOV/Express Bus Access Study

Valley Road intersection and enter the freeway on the left-side via the northbound direct on ramp. Other associated work is similar to that listed under Options A and B and includes:

- Widening of I-680 to create the needed room in the median for the direct access ramps; this would require right-of-way acquisition mostly along the west side of I-680.
- Modifications to and widening of the three existing undercrossing structures at Ygnacio Valley Road.
- Relocation of the loop on-ramp from Ygnacio Valley Road to SR 24 westbound.
- Extension of the northbound HOV auxiliary lane beyond the minimally required length to meet the future northbound HOV lane that is planned to the north of the North Main Street Overcrossing.

Advantages:

- Buses and HOVs would not need to weave from the HOV lane to the right exit across all lanes of traffic.
- Buses and HOVs would reduce their travel on local streets in the vicinity of the Walnut Creek BART station, thereby reducing the travel time for those vehicles.
- Reduction in vehicle traffic on the Lawrence Way northbound on-ramp to I-680, which is congested during the evening peak period, due to fewer vehicles using this on-ramp.
- The HOV direct connector ramps would connect to a public roadway. This would provide access for HOVs with non-BART destinations in downtown Walnut Creek, which might help with the interchange justification process with FHWA.

Disadvantages:

- Significant impacts to the residential area west of I-680.
- Ygnacio Valley Road is congested during the morning and evening peak periods. This option would create another signalized intersection on Ygnacio Valley Road in close proximity to the I-680 southbound on-ramp, the SR 24 westbound on-ramp, and the signalized intersection at N. California Boulevard.
- The new access created from this option is not compatible with the planned bus and vehicle circulation routes in and out of the BART station, which would reduce the savings in travel time.
- Freeway improvements would extend further south than Options A or B, and could potentially impact the BART overpass or the I-680/SR 24 interchange. More detailed design would be needed to assess these potential impacts.

5.2.4 Option D: HOV Direct Connector Ramps to North Main Street

This option, illustrated in **Figure 5-5**, would provide HOV direct connector ramps to North Main Street for buses and HOVs traveling to the Walnut Creek BART Station. Buses and HOVs traveling south on I-680 would exit the HOV lane via the new ramp that ascends to form an L-shaped two-way stop-controlled intersection. The buses and HOVs would turn

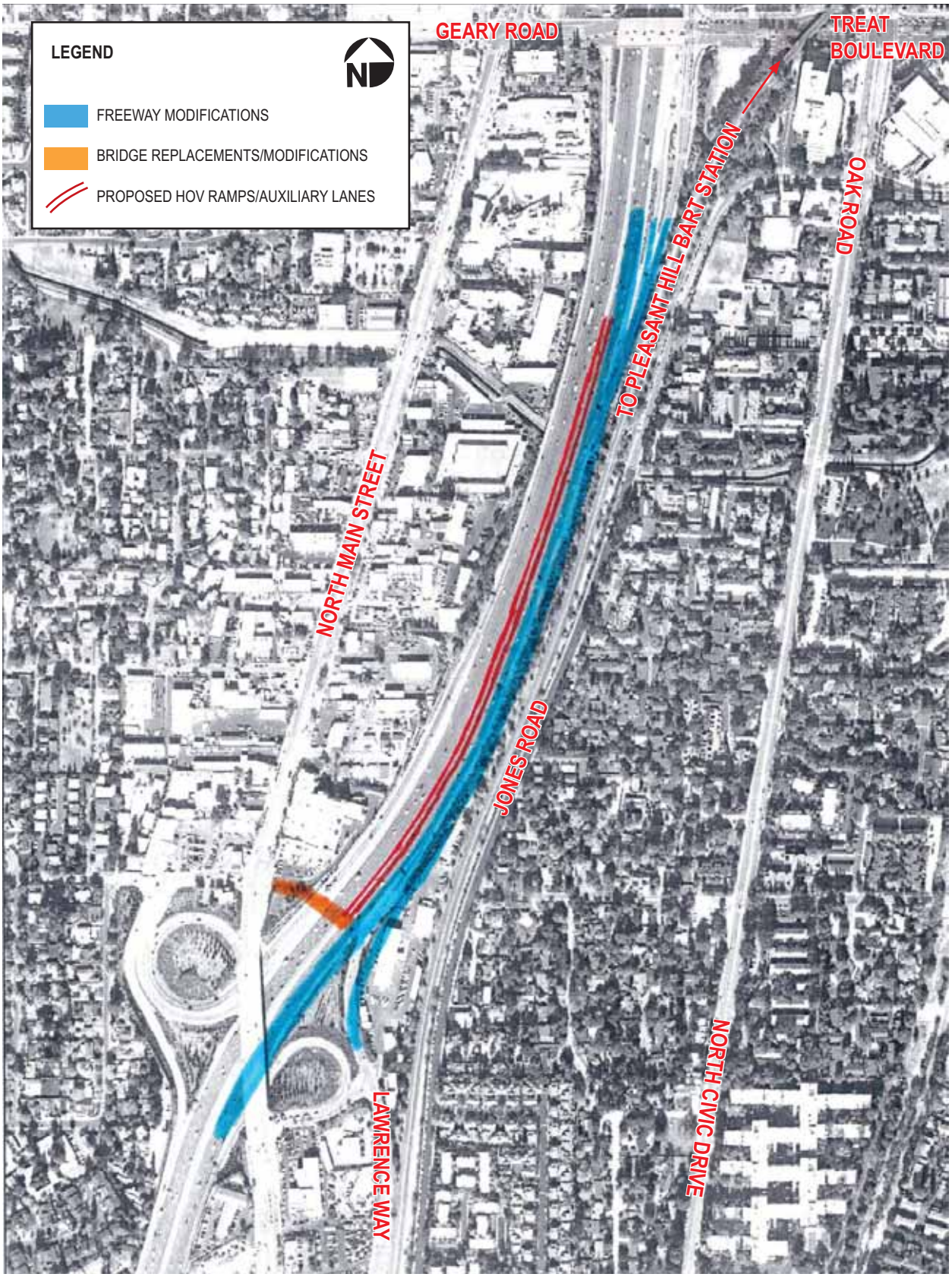


FIGURE 5-5
Option D: HOV Direct Connector Ramps to North Main Street
I-680 HOV/Express Bus Access Study

right and cross over the I-680 southbound lanes and the North Main Street off-ramp via a new overcrossing, then connect to the existing North Main Street/San Luis Road intersection. The buses and HOVs accessing northbound I-680 could also use the structure over the I-680 southbound lanes and enter the freeway on the left side via the northbound direct on-ramp. Other associated work would include:

- Widening of I-680 to create the needed room in the median for the direct access ramps; this would require right-of-way acquisition mostly along the east side of I-680.
- Realignment of the on-ramp from Lawrence Way to the east. This would likely require at least a partial take of the current Walnut Creek Corporation Yard.

Advantages:

- Buses and HOVs would not need to weave from the HOV lane to the right exit across all lanes of traffic.
- Buses and HOVs would reduce their travel on local streets in the vicinity of the Walnut Creek BART station, thereby reducing the travel time for those vehicles.
- Reduction in vehicle traffic on the Lawrence Way northbound on-ramp to I-680, which is congested during the evening peak period, due to fewer vehicles using this on-ramp.
- The HOV direct connector ramps would connect to a public roadway. This would provide access for HOVs with non-BART destinations in downtown Walnut Creek, which might help with the interchange justification process with FHWA.

Disadvantages:

- The touch-down of this ramp at the North Main Street/San Luis Road intersection would impact the existing access to the commercial property (OfficeMax and others) in the northeast corner of that intersection and eliminate parking spaces on the property.
- Right-of-way impacts to the City of Walnut Creek Corporation Yard.
- More travel on surface streets than Options A, B or C.

5.2.5 Option E: HOV Direct Connector Ramps to Coggins Drive/Oak Park Boulevard

This option, illustrated in **Figure 5-6**, would provide HOV direct connector ramps to the overcrossing at Coggins Drive/Oak Park Boulevard for buses and HOVs traveling to/from the Pleasant Hill BART Station. Ramps would be provided in the median of the freeway and ascend to form a T-shaped signalized intersection with Coggins Drive/Oak Park Boulevard. Because of the need for a wider freeway cross-section, the existing Coggins Drive/Oak Park Boulevard Overcrossing would have to be replaced with a longer structure. Other associated work would include:

- Widening of I-680 to create the needed room in the median for the direct connector ramps; this would require right-of-way acquisition mostly along the west side of I-680.
- Realignment of Contra Costa Boulevard/North Main Street to the west.
- Realignment of Buskirk Avenue to the east.

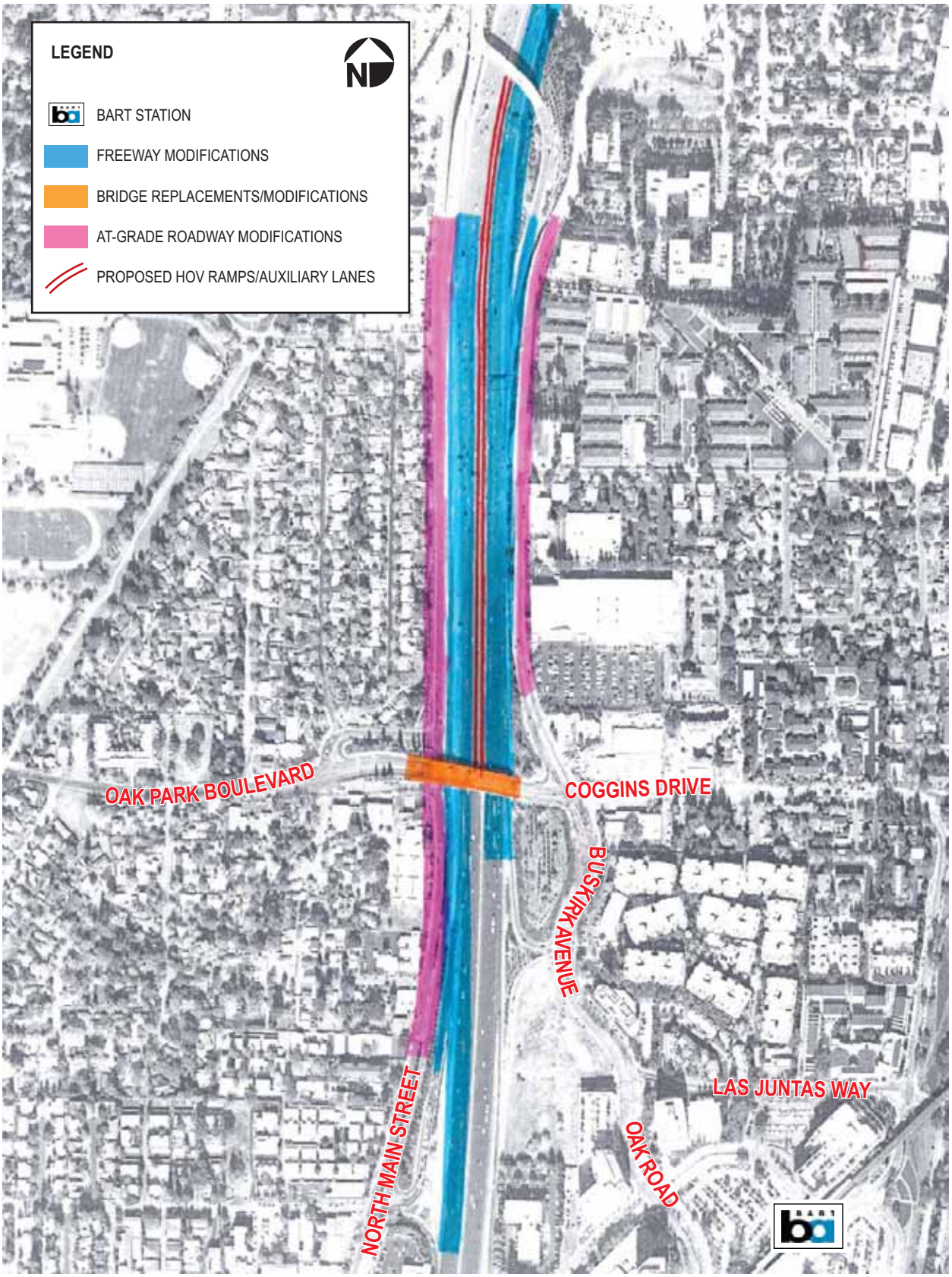


FIGURE 5-6
Option E: HOV Direct Connector Ramps to Coggins Drive/Oak Park Boulevard
I-680 HOV/Express Bus Access Study

Advantages:

- Buses and HOVs would not need to weave from the HOV lane to the right exit across all lanes of traffic.
- Buses and HOVs would reduce their travel on local streets currently used to access the Pleasant Hill BART Station, thereby reducing the travel time for those vehicles. This option would improve the existing bus circulation routes on local streets such as Monument Boulevard, Buskirk Avenue and Contra Costa Boulevard.
- Reduction in vehicle traffic on Treat Boulevard southbound off-ramp, the North Main Street/Treat Boulevard intersection, and the Monument Boulevard/Buskirk Avenue intersection that are congested during the morning and evening peak period.

Disadvantages:

- Significant right-of-way acquisition required from the residential area west of I-680, and the commercial property at the corner of Oak Park Boulevard and North Main Street (Black Angus Restaurant).

5.2.6 Option F: HOV Direct Connector Ramps to a New Overcrossing Between Treat Boulevard and North Main Street

This option, illustrated in **Figure 5-7**, would provide HOV direct connector ramps to a new overcrossing between the Treat Boulevard and North Main Street interchanges (south of the canal). Ramps would be provided in the median of the freeway and ascend to form an L-shaped two-way stop-controlled intersection. Using the new overcrossing, buses and HOVs would cross over the I-680 northbound lanes and connect to a new elevated roadway that would then provide access to both the Walnut Creek and Pleasant Hill BART Stations. This roadway would be bi-directional and run parallel to the BART tracks, beginning at the Lawrence Way/Penniman Way intersection and connecting to Jones Road. In addition, it would need to cross over the BART tracks. This option could operate as a bus-only facility. Other associated work would include:

- Widening of I-680 to create the needed room in the median for the direct connector ramps; this would require right-of-way acquisition mostly along the west side of I-680.
- Modifications to and widening of the existing overcrossing structure at Treat Boulevard.
- Relocation of the Sunnyvale Avenue on- and off-ramps to southbound I-680.
- Modification to the Treat Boulevard on-ramp to southbound I-680.
- Redesign of the truck weigh scales on the west side of I-680 north of Treat Boulevard.
- Realignment of North Main Street to the west.

Advantages:

- Buses and HOVs would not need to weave from the HOV lane to the right exit across all lanes of traffic.

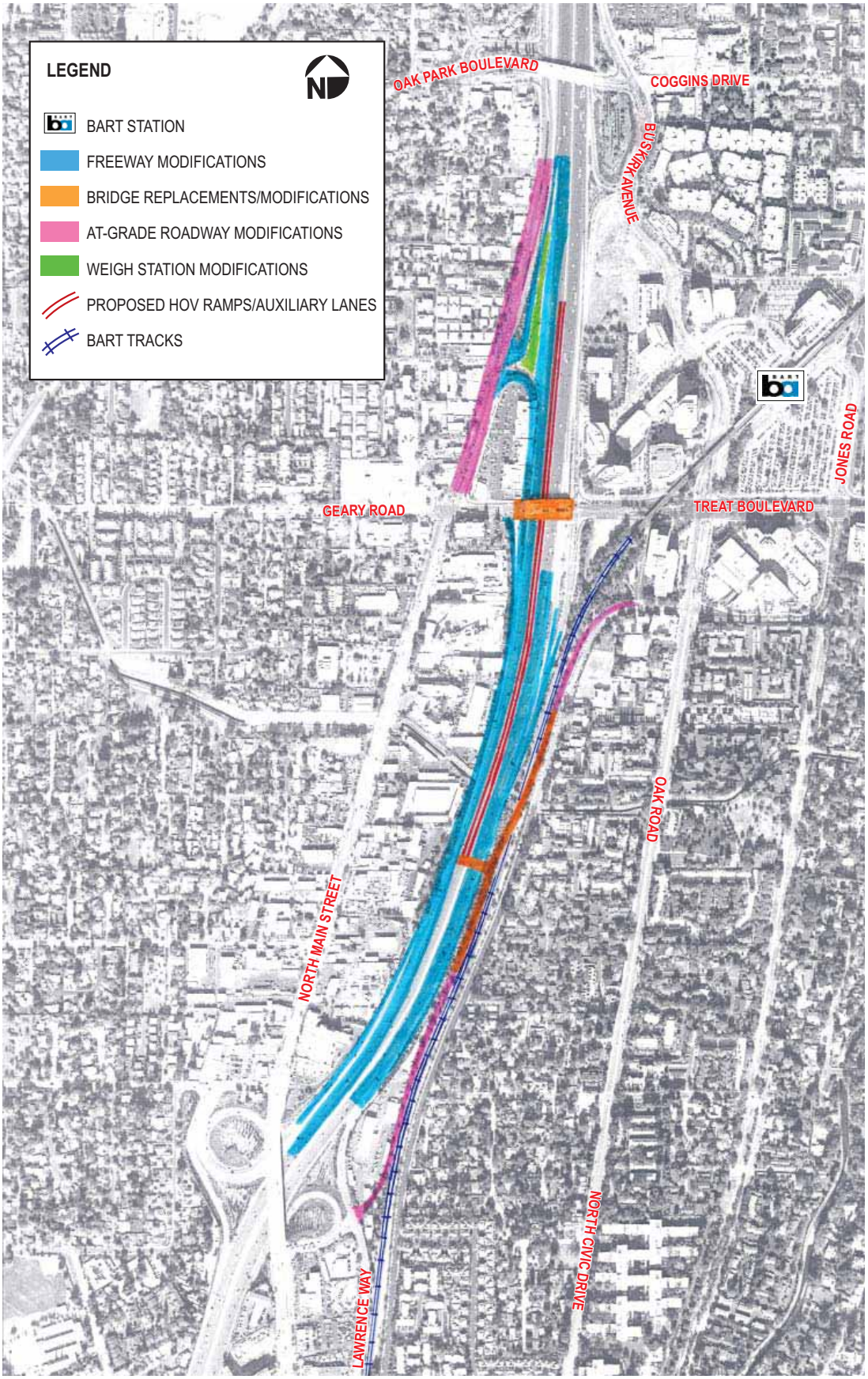


FIGURE 5-7
Option F: HOV Direct Connector Ramps to New Overcrossing Between Treat Boulevard and North Main Street
I-680 HOV/Express Bus Access Study

- Buses and HOVs would reduce their travel on local streets currently used to access the Pleasant Hill BART Station, thereby reducing the travel time for those vehicles. This option would improve the existing bus circulation routes on local streets such as Monument Boulevard, Buskirk Avenue and Contra Costa Boulevard. The new roadway would take traffic off of Oak Road and North Main Street, which are used to access the Walnut Creek BART Station.
- Reduction in vehicle traffic on Treat Boulevard southbound off-ramp, the North Main Street/Treat Boulevard intersection, and the Monument Boulevard/Buskirk Avenue intersection that are congested during the morning and evening peak periods.
- Provides a surface street connection between the Walnut Creek and Pleasant Hill BART Stations.

Disadvantages:

- Right-of-way impacts to the commercial property at the northwest quadrant of the Treat Boulevard interchange.
- Right-of-way impacts to residential properties abutting North Main Street to the west.
- Impacts to the weigh station on the west side of I-680.
- Significant bridge structures to be constructed in order to clear the existing BART tracks.
- Impacts to the commercial development in the vicinity of Treat Boulevard and I-680.
- Increase in vehicle traffic on Jones Road, a two-lane street serving the local residential area.

5.2.7 Preliminary Conclusions

The CH2M HILL team selected Alternatives B and E to be brought forward for further evaluation. Alternative B (HOV Direct Connector Ramps to Walnut Creek BART Perimeter Road) would provide both buses and HOVs a direct connection to the Walnut Creek BART Station, and its proposed access point would be compatible with the planned transit-oriented development. In addition, Alternative B would not require passengers on the HOVs and buses to take stairs or elevations to get to the ground-level bus terminals or BART station entrance.

Alternative E (HOV Direct Connector Ramps to Coggins Drive/Oak Park Boulevard) would provide the most direct access to the Pleasant Hill BART station and would avoid impacts to the significant commercial development in the vicinity of Treat Boulevard and I-680. In addition, it would shift traffic from highly congested roadways to the less congested Coggins Drive.

In developing these recommendations, an assessment of the six HOV Direct Connector Ramp options was conducted based on how well they would improve HOV/transit system access and connectivity; how well they would meet the Regional Measure 2 goals; and their potential impact on traffic operations, constructibility and cost. A summary of this assessment is provided in **Table 5-2**. This table is similar in format to the screening

TABLE 5-2
Assessment of HOV Direct Connector Ramp Options

HOV Direct Connector Ramp Option		HOV/Transit System Access and Connectivity	Regional Measure 2 Goals	Traffic Operations	Constructibility	Cost
A.	To Top of Walnut Creek BART Parking Garage	●	●●	●	○○	○○
B.	To Walnut Creek BART Perimeter Road	●●	●●	●	○	○
C.	To Ygnacio Valley Road	●	●●	◉	○○	○
D.	To North Main Street	●	◉	●	○	○
E.	To Coggins Drive/Oak Park Boulevard	●●	●●	●	○	○
F.	To a New Overcrossing Between Treat Boulevard and North Main Street	●	●	◉	○○	○○

Legend:

●● Significant benefit (two solid green circles)
● Measurable benefit (one solid green circle)
◉ Neutral (blue bullseye)
○ Measurable disbenefit (one open black circle)
○○ Significant disbenefit (two open black circles)
✕ Fatal flaw (red “x”)

conducted (and summarized later in this memo) for the Other Arterial and Freeway Improvement Options.

5.3 Other Arterial and Freeway Improvements

For this study, seven Other Arterial and Freeway Improvement options were developed. These options, which focus primarily on the roadway system in the vicinity of the Walnut Creek and Pleasant Hill BART stations, were then screened based on the criteria identified in Section 4 of this report. In this section a description of each option is provided, the results of the screening process are summarized, and the options carried forward for evaluation are identified.

To help identify potential Other Arterial and Freeway Improvements, a brainstorming session involving TAC and CH2M HILL team members was held on June 27, 2008. The ideas generated at this session, along with others provided by TAC and CH2M HILL team members, were used to develop the options presented in this memorandum. While some ideas were not carried forward after an initial assessment of their feasibility, others were combined as part of the options presented below. One idea, the re-routing of buses to use Oak Road and Jones Road to access Pleasant Hill BART Station from Walnut Creek BART Station, has not been included because this re-routing has already been implemented.

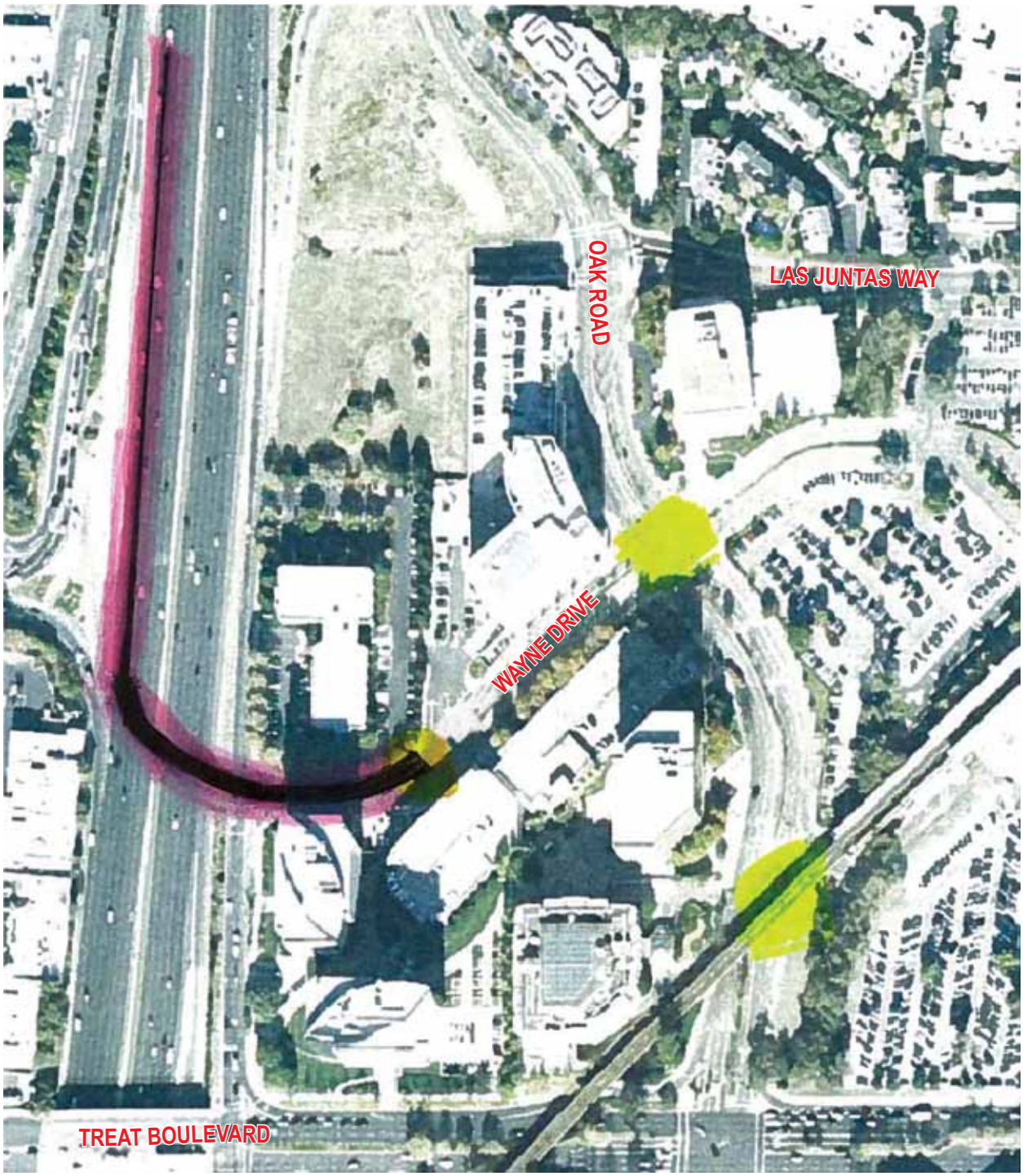
The seven options that were developed for screening include new freeway ramps, arterial improvements, and transit improvements. The options are summarized in **Table 5-3**.

TABLE 5-3
List of Other Arterial and Freeway Improvement Options

A.	I-680 southbound mixed-flow off-ramp to Wayne Drive (plus transit signal priority and bus re-routing)
B.	I-680 southbound mixed-flow off-ramp to Buskirk Avenue (plus transit signal priority and bus re-routing)
C.	Raise North Main Street to intersect with Coggins Drive (plus transit signal priority and bus re-routing)
D.	Buskirk Avenue Improvements (plus transit signal priority and physical improvements)
E.	Long distance express bus consolidation from Pleasant Hill BART to Walnut Creek BART
F.	Transit signal priority/queue jump lanes
G.	New bus transit center with separate parking

5.3.1 Option A: I-680 Southbound Mixed-flow Off-ramp to Wayne Drive

As illustrated in **Figure 5-8**, Option A would involve the construction of a new off-ramp from I-680 southbound to Wayne Drive. The ramp would begin south of the Coggins Drive overpass before flying over I-680 and touching down on Wayne Drive east of Buskirk Avenue. The ramp would be a mixed-flow facility and would not be limited to buses or HOVs.



LEGEND

NEW RAMP

TRAFFIC SIGNAL PRIORITY

FIGURE 5-8
Option A: Southbound Mixed Flow
Off-Ramp to Wayne Drive
I-680 HOV/Express Bus Access Study

The purpose of this ramp would be to provide more direct access to the Pleasant Hill BART station for commuters and buses coming from the north. Currently, access to the Pleasant Hill BART station from I-680 southbound involves passing through five intersections via the North Main Street off-ramp, Treat Boulevard, and Oak Road or Jones Road. Access via the new ramp would involve only two intersections.

Transit signal priority (TSP) and transit bus re-routing would also be employed to take advantage of the new off-ramp.

5.3.2 Option B: I-680 Southbound Mixed-flow Off-ramp to Buskirk Avenue

As illustrated in **Figure 5-9**, Option B would involve the construction a new off-ramp from I-680 southbound to Oak Road. The ramp would begin north of the Coggins Drive overpass and would require an aerial loop structure over Contra Costa Boulevard and adjacent properties before touching down on the east side of I-680 at Buskirk Avenue. The ramp would be a mixed-flow facility and would not be limited to buses or HOVs.

Similarly to Option A, the purpose of this ramp would be to provide more direct access to the Pleasant Hill BART Station for commuters and buses coming from the north. In addition to fewer intersections between the off-ramp and the BART station, commuters and buses would have the option to exit the freeway earlier than they do today, thus avoiding recurrent congestion on I-680 southbound.

TSP and transit bus re-routing would also be employed to take advantage of the new off-ramp.

5.3.3 Option C: Raise North Main Street to Intersect with Coggins Drive

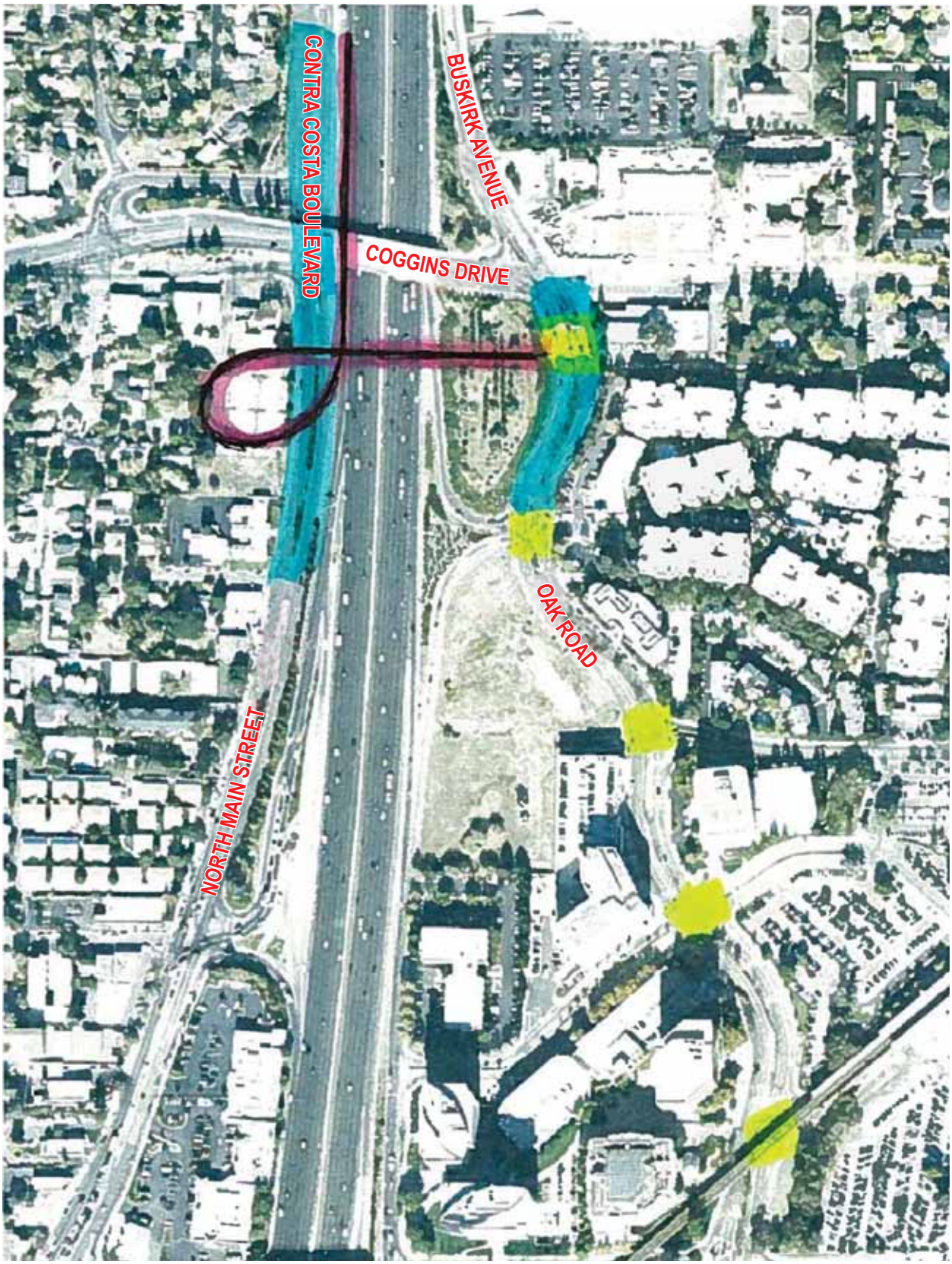
Currently, North Main Street is grade separated from Coggins Drive, running underneath the Coggins Drive overpass. A loop road consisting of Pleasant Valley Drive and Oak Park Boulevard facilitate travel between the two facilities. As illustrated in **Figure 5-10**, Option C proposes to raise North Main Street to meet the Coggins Drive overpass at a signalized intersection, thus avoiding the circuitous route currently necessary to travel from North Main Street to Buskirk Avenue via Coggins Road.

The purpose of this option is to improve bus travel through the corridor. TSP would also be implemented along Coggins Drive and Buskirk Avenue to further improve transit travel times.

5.3.4 Option D: Buskirk Avenue Improvements

Buskirk Avenue runs from Monument Boulevard south to Treat Boulevard. As illustrated in **Figure 5-11**, Option D seeks to improve the roadway through geometric modifications, roadway realignment, and intersection modifications, including TSP.

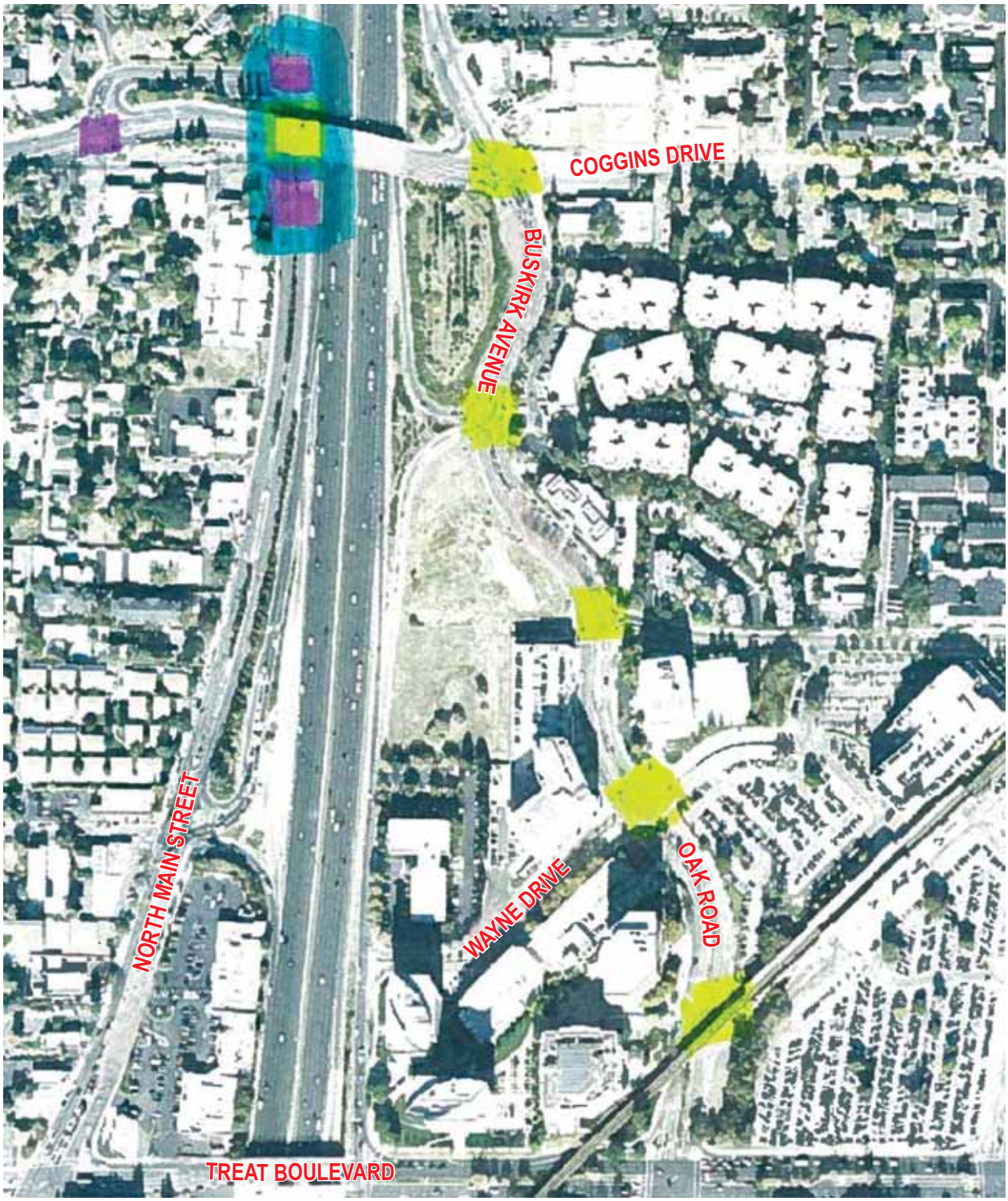
For buses traveling from Monument Boulevard to the Pleasant Hill BART station, improvements to Buskirk Avenue would contribute to faster and more reliable transit travel times. Improvements would remove one all-way stop intersection and improve the alignment of Buskirk Avenue between Mayhew Way and Monument Boulevard.



LEGEND

- NEW RAMP
- ARTERIAL WORK
- TRAFFIC SIGNAL PRIORITY

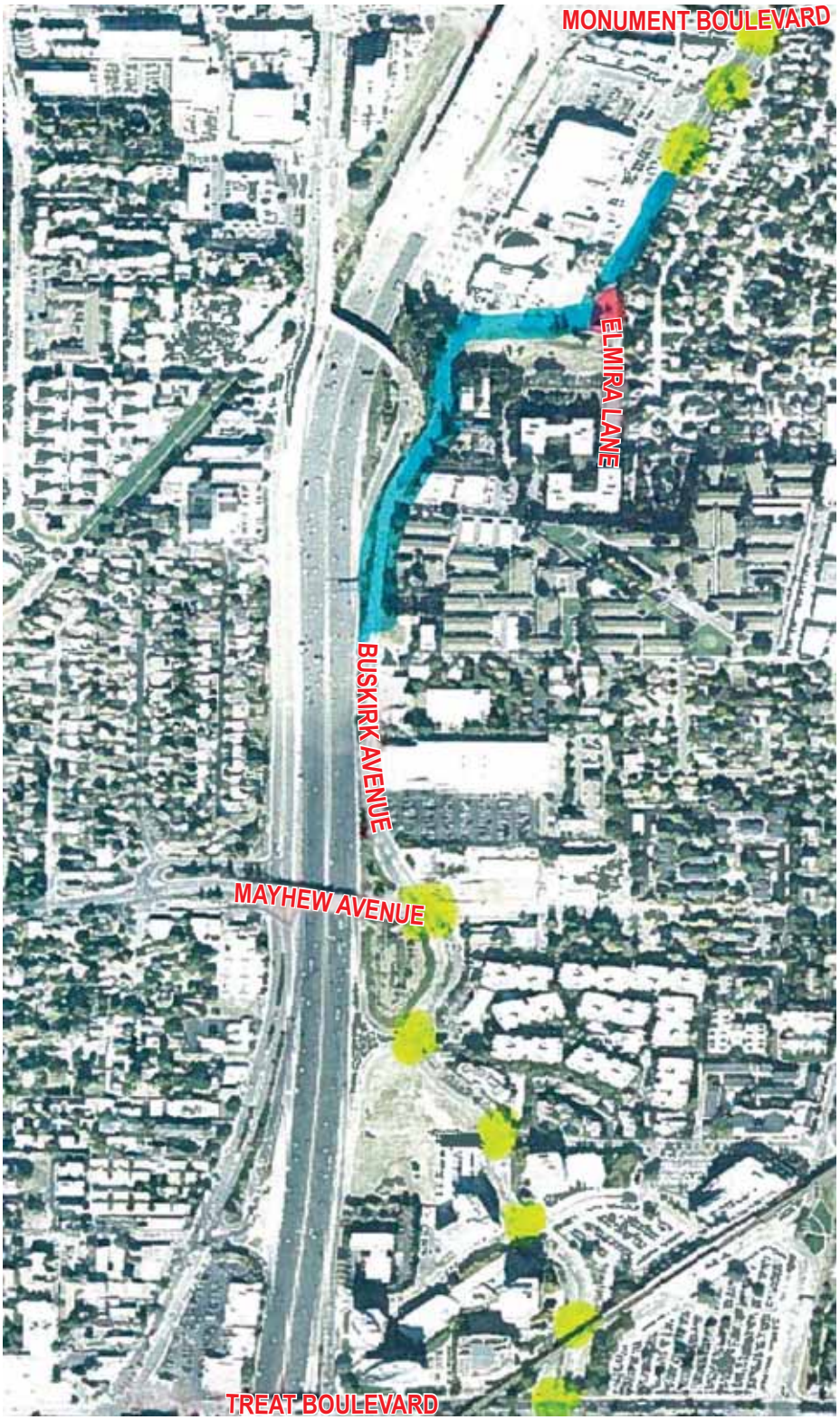
FIGURE 5-9
Option B: Southbound Mixed Flow
Off-Ramp to Buskirk Avenue
I-680 HOV/Express Bus Access Study



LEGEND

- REMOVE TRAFFIC SIGNAL
- PROPOSED IMPROVEMENT
- TRAFFIC SIGNAL PRIORITY

FIGURE 5-10
Option C: Raise North Main Street to Coggins Drive
I-680 HOV/Express Bus Access Study



N

LEGEND

REMOVE TRAFFIC SIGNAL

BUSKIRK AVENUE

ELMIRA LANE

PROPOSED IMPROVEMENT
- IMPROVE ROADWAY CONDITIONS
- REALIGN BUSKIRK AVENUE NEAR HOOKSTON ROAD

TRAFFIC SIGNAL PRIORITY

FIGURE 5-11
Option D: Buskirk Avenue Improvements
I-680 HOV/Express Bus Access Study

5.3.5 Option E: Long Distance Express Bus Consolidation at Walnut Creek BART Station

Currently, a number of long distance express bus routes traveling to and from the north terminate at the Pleasant Hill BART Station, while those traveling to and from the south terminate at the Walnut Creek BART Station. As illustrated in **Figure 5-12**, the proposed routing in Option E would consolidate all long distance express bus service at the Walnut Creek BART Station. TSP would also be implemented at the intersections between I-680 and the Walnut Creek BART Station to improve transit travel times.

By consolidating the long distance express bus service at the Walnut Creek BART Station, a regional bus hub would be created that brings the north oriented bus service (such as those from Solano County) together with the south oriented bus service (such as those serving San Ramon/Bishop Ranch).

5.3.6 Option F: Transit Signal Priority/Queue Jump Lanes

Under Option F, TSP and/or queue jump lanes would be installed on the intersections between I-680 and the Pleasant Hill and Walnut Creek BART stations. These improvements would be to the surface streets that express buses use to access the BART stations and would help lower travel times and increase service reliability. As shown in **Figure 5-13**, there are approximately 13 intersections that would be affected by Option F.

5.3.7 Option G: New Bus Transit Center

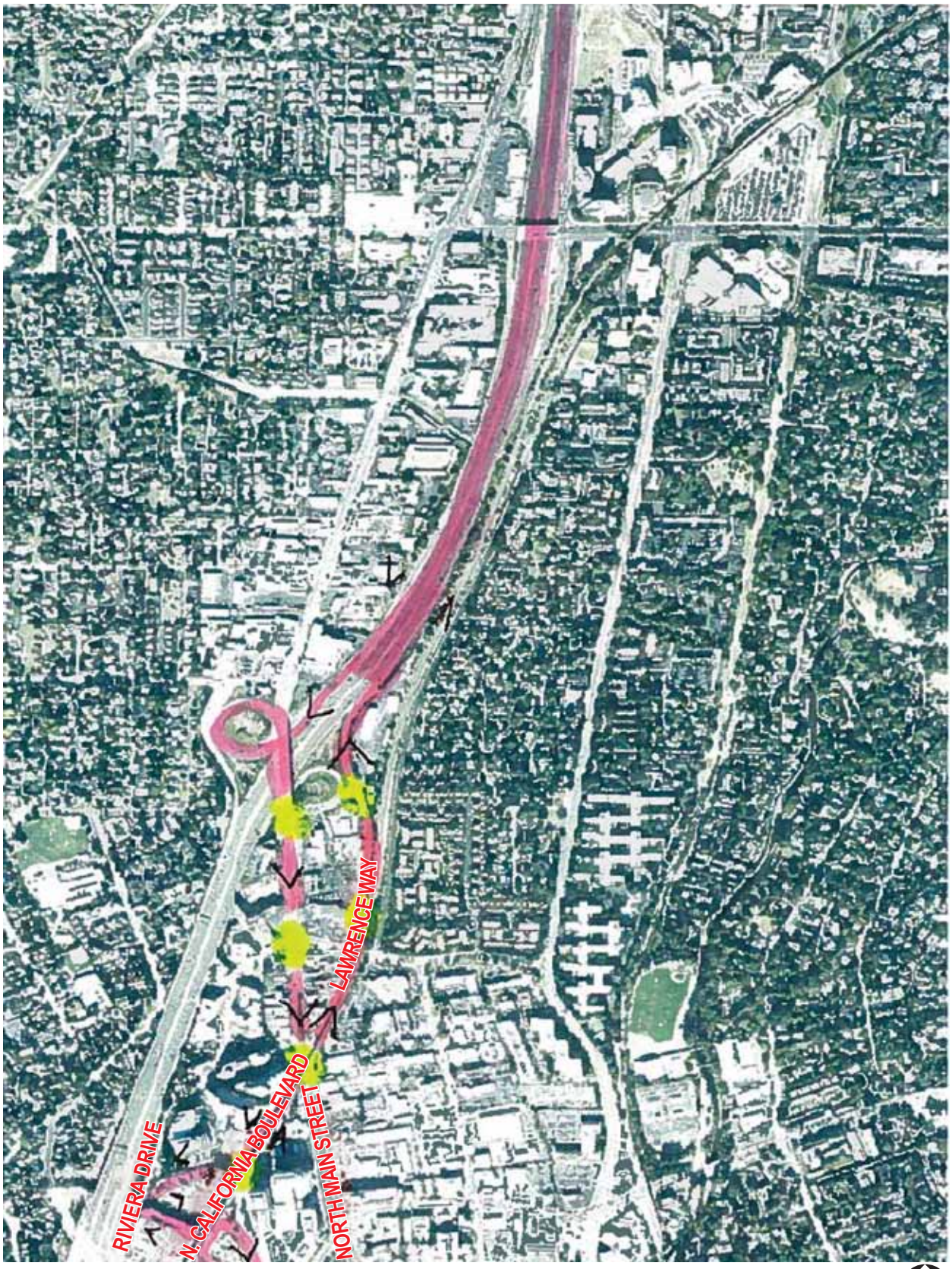
Under Option G, a new bus transit center that is separate from the current BART stations would be constructed. This center would serve as a hub for both express and local bus services. Parking would be provided at the proposed transit center. Long distance express bus service would be rerouted away from the Pleasant Hill and Walnut Creek BART stations and instead would serve the proposed transit center.

As illustrated in **Figure 5-14**, a potential site for this new bus transit center is between Lawrence Way and Jones Road at the I-680 and North Main Street interchange. This is the current City of Walnut Creek Corporation Yard. Because this site is not immediately adjacent to the BART station, a direct linkage to one or both BART stations would be desirable. Alternatively, the bus transit center could be sited adjacent to one of the BART stations allowing for easy walk access between the two facilities. The potential for direct linkages and possible alternative sites will be assessed during the evaluation phase for this study.

This option would provide better linkage between the north- and south-oriented express bus services, a link to local bus routes, and by providing parking could serve the currently underserved market for park-and-ride express bus transit.

5.3.8 Screening Results for Other Arterial and Freeway Improvements

The screening criteria presented in Section 4 of this report were applied to each option based on a qualitative assessment of available data, field observations, and engineering judgment. The results of the screening are provided in **Table 5-4.** Supporting information for many of the criteria assessments are provided in the notes following the table.

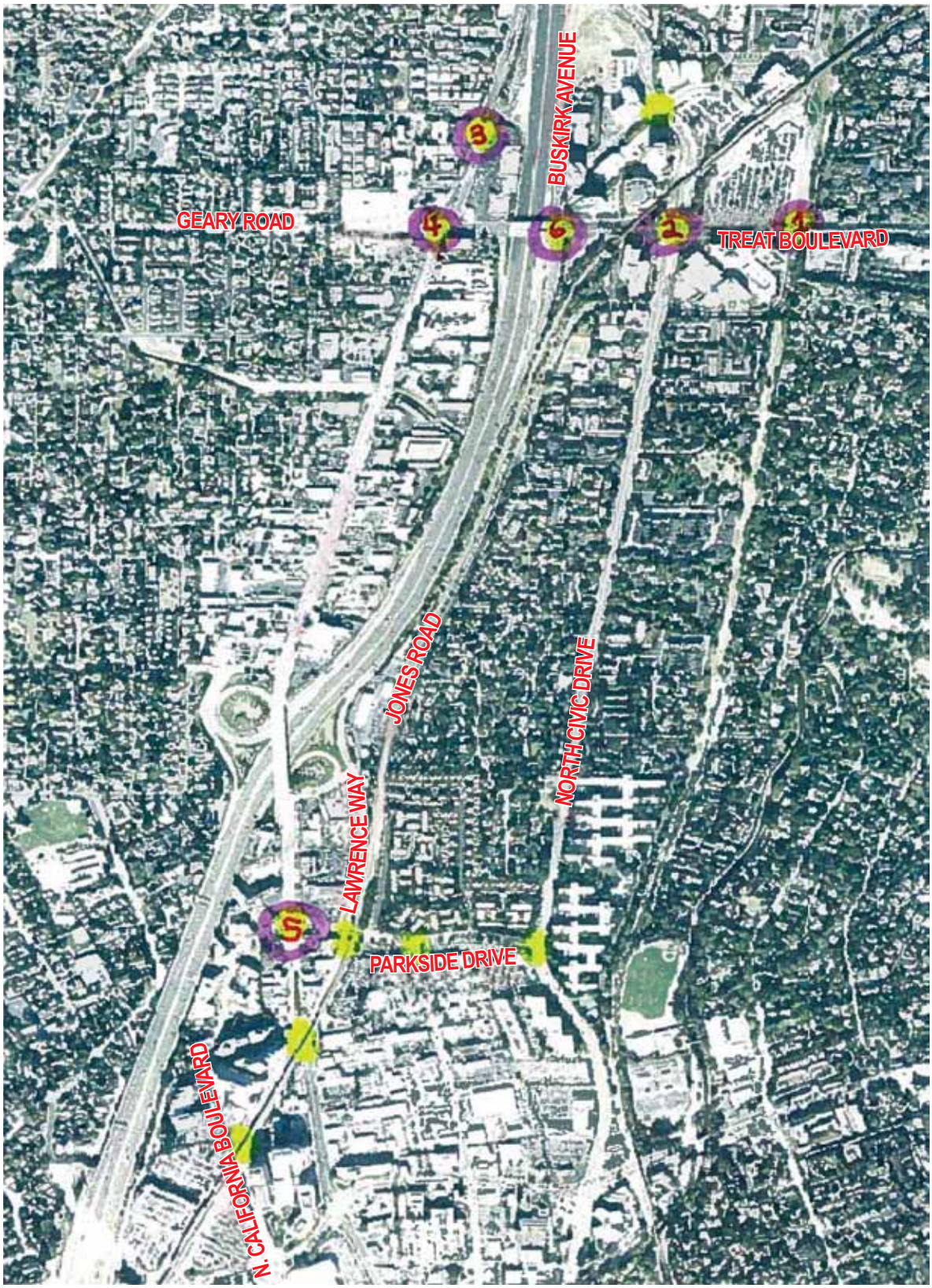


LEGEND

PROPOSED ROUTE

TRAFFIC SIGNAL PRIORITY

FIGURE 5-12
Option E: Long Distance Express Bus Consolidation at Walnut Creek BART
I-680 HOV/Express Bus Access Study



LEGEND

TRAFFIC SIGNAL PRIORITY/ QUEUE JUMP
**IF ROUTE PASSES THROUGH INTERSECTION*

TRAFFIC SIGNAL PRIORITY ONLY

FIGURE 5-13
Option F: TSP/Queue Jump Lanes
I-680 HOV/Express Bus Access Study

LEGEND

PROPOSED TRANSIT CENTER

N

FIGURE 5-14
Option G: New Bus Transit Center
I-680 HOV/Express Bus Access Study

TABLE 5-4
Screening Results for Other Arterial and Freeway Improvement Options

Option	HOV/Transit System Access and Connectivity	Traffic Operations	Safety	Environmental Constraints[1]	Planning Consistency	Constructibility	Cost
A. SB Mixed-flow off-ramp to Wayne Drive (Transit Signal Priority [TSP], Bus Routing)	●	○[2]	✕[3]	○	○[4]	○	○○
B. SB Mixed-flow off-ramp to Buskirk Avenue (TSP, Bus Routing)	●	○[2]	○○[3]	○○	○[4]	○○[5]	○○
C. Raise North Main Street to Coggins Drive (TSP, Bus Routing)	◉	●[6]	●[7]	○[8]	◉	○	○
D. Buskirk Avenue Improvements (TSP, Physical Improvements)	◉	●	●	●[9]	●●[10]	●	◉
E. Bus re-routing from Pleasant Hill BART to Walnut Creek BART	●●[11]	◉	◉	●●	◉[12]	●●	●●
F. TSP/Queue Jump Lanes	◉	◉[13]	◉	●●[14]	◉	●●	●
G. New Bus Transit Center with Separate Parking[15]	●[16]	◉[17]	◉	◉	○[12]	●	○○

Notes:

1. This criteria considers hazardous materials, visual, noise and ROW/displacement.
2. Some improvement by re-distributing traffic from Treat and Monument, but creates new signalized intersections and/or approaches to existing intersections. Also creates short weaving sections in I-680.
3. Would create a short weave on I-680. For Option A, also would create a decision point with three possible destinations (Wayne, Treat, truck scale).
4. May conflict with future HOV direct connector ramps. Does not link directly to HOV lane.
5. Would impact Contra Costa Boulevard, I-680, and Buskirk Avenue.

Legend:

- ●● Significant benefit (two solid green circles)
- ● Measurable benefit (one solid green circle)
- ◉ Neutral (blue bullseye)
- ○ Measurable disbenefit (one open black circle)
- ○○ Significant disbenefit (two open black circles)
- ✕ Fatal flaw (red "x")

TABLE 5-4
Screening Results for Other Arterial and Freeway Improvement Options

Option	HOV/Transit System Access and Connectivity	Traffic Operations	Safety	Environmental Constraints[1]	Planning Consistency	Constructibility	Cost

6. Could potentially eliminate looping through three existing signals.
7. Would reduces the number of intersections and turns needed.
8. Noise and visual impacts to surrounding neighborhood.
9. This assessment could change if hazardous materials associated with the existing gas station are identified.
10. Option is included in the RTP.
11. Connects north express buses, south express buses, and BART in one location. While north express buses lose access to Pleasant Hill local routes, they gain direct access to Walnut Creek local routes which serve more employment centers.
12. Inconsistent with current designation of Pleasant Hill BART as a regional transit hub.
13. Limited number of buses would result in little overall impact on traffic operations.
14. As proposed, queue jump lane improvements would be accommodated within existing ROW.
15. This option would require parking to serve the express buses. Ideally, would be located near or have a good connection to BART (i.e., people mover, shuttle buses, etc.).
16. With parking, could then serve those who drive to take the bus or car/vanpool.
17. May reduce some vehicle trips, but would affect intersections adjacent to new facility.

5.3.9 Other Arterial Improvements to be Evaluated

From the screening process, the CH2M HILL team recommended that three of the Other Arterial and Freeway Improvements options be brought forward for further evaluation under the Prioritization process: Options D, E, and F (**Table 5-5**). Because all of the recommended options are arterial-based, this category of options was given the revised title of Other Arterial Improvement Options.

TABLE 5-5
Other Arterial Improvement Options Recommended for Further Evaluation

Option	Description
D.	Buskirk Avenue Improvements (plus transit signal priority and physical improvements)
E.	Express Bus re-routing from Pleasant Hill BART to Walnut Creek BART
F.	Transit signal priority/queue jump lanes

Option A, the mixed-flow ramp to Wayne Drive, was found to have a fatal flaw in the safety metric, eliminating it from future consideration. Option B, the mixed-flow ramp to Buskirk Avenue, was found to have significant disbenefits in multiple evaluation categories with only a measurable benefit in HOV system access and connectivity, and thus was eliminated from future consideration as well. Option C, raising North Main Street to intersect with Coggins Drive, would have minimal benefit to transit and HOV connectivity while negatively impacting the adjacent residential neighborhood. Option G, the new bus transit center, would require relocating the City of Walnut Creek Corporation Yard, which would likely result in a very high cost because there is not a readily apparent alternative site.

6.0 Evaluation of Conceptual Options

The evaluation of the conceptual options for the I-680 HOV/Express Bus Access Study is discussed in this section. This evaluation was the basis for prioritizing the specific options for investment as defined in the Regional Measure 2 legislation. The prioritization is described in Section 7 of this report. In addition, Other Arterial Improvement options that are not necessarily eligible for RM 2 funding were evaluated and prioritized for future funding.

6.1 Description of Options Evaluated

6.1.1 Regional Measure 2 Investment Options

Two options were evaluated for the purpose of selecting one option to be recommended for use of available RM 2 funds. Both of these options are capital improvements on I-680 that serve express buses and HOVs. Some minor refinements were made to the evaluated options after the screening process, and a description of each of these options is provided below.

6.1.1.1 Option 1: Southbound I-680 HOV Lane Gap Closure Project

This project is included in the Regional Transportation Plan, and proposes to close the existing gap in the southbound I-680 HOV lane from 0.2 mile north of the Geary Road interchange, through the SR 24 interchange and to the Livorna Road interchange. The boundaries of this project are illustrated in **Figure 6-1**. The information used in this evaluation was taken from the Draft PSR (PDS) for the Southbound I-680 HOV Lane Gap Closure project.

As explained above in Section 5.1, Alternative 1 from the Draft PSR was evaluated in this study. This alternative would widen the existing roadway to add a median HOV lane from 0.2 mile north of Livorna Road to 500 feet north of South Main Street Undercrossing, and re-stripe the existing roadway from South Main Street to 0.4 mile north of North Main Street to continue the HOV lane to just north of Geary Road, without any right-of-way acquisitions. This alternative would require reducing the widths of the left shoulder and of some of the inside lanes. The project would include reconstructing retaining and sound walls, widening bridges, restriping the existing roadway, modifying existing fiber optical cable and traffic operations systems, installing ramp metering systems, and upgrading median barrier to standard. A more detailed conceptual drawing of this option is provided in **Appendix A**.

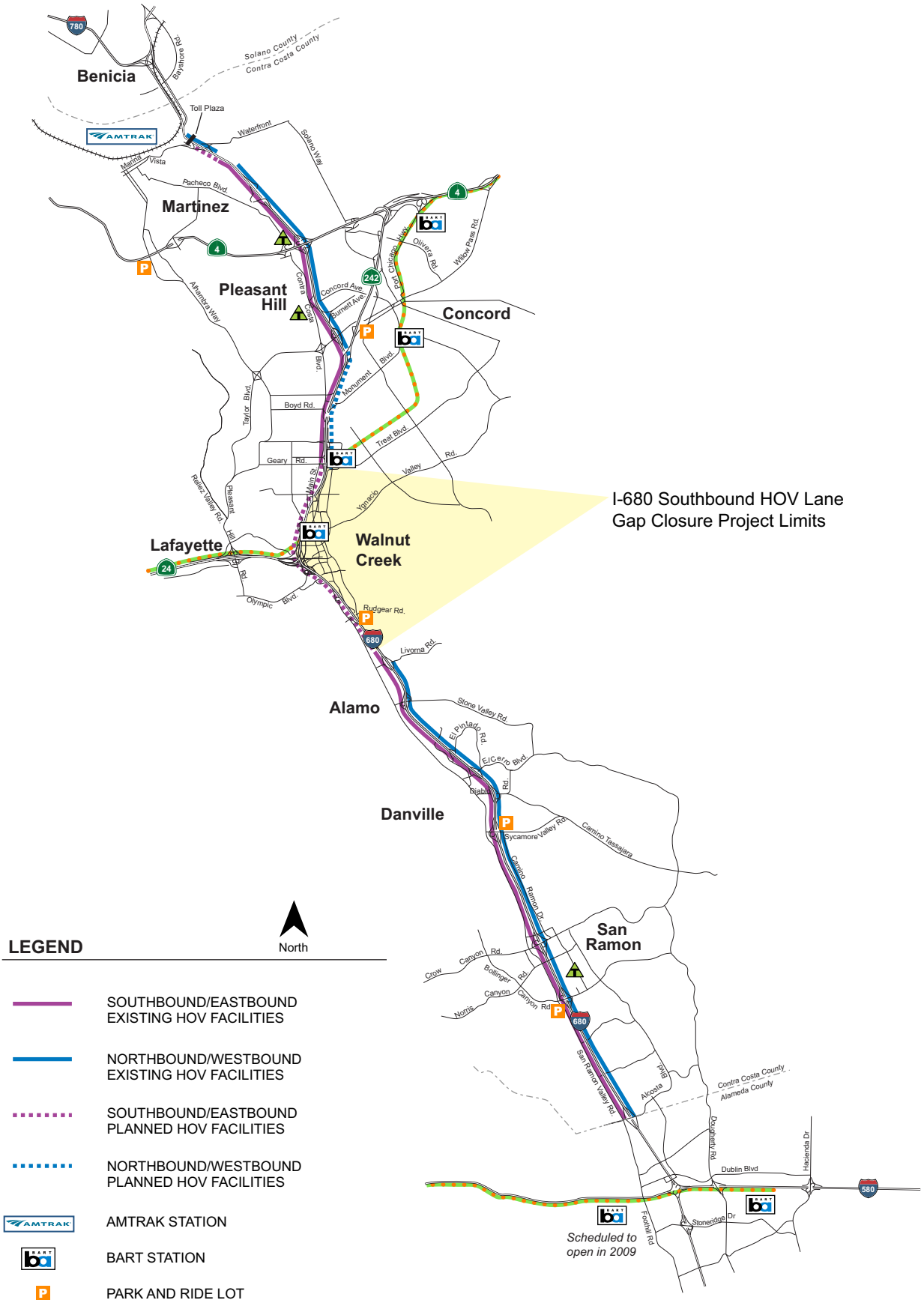


FIGURE 6-1
I-680 Southbound HOV Lane
Gap Closure Project Limits
I-680 HOV/Express Bus Access Study

6.1.1.2 Option 2: I-680 HOV Direct Connector Ramps to Walnut Creek BART Perimeter Road

The HOV direct connector ramps in the selected option, illustrated in **Figure 6-2**, would serve both express buses and HOVs coming from and going to the north of the Walnut Creek BART Station. Express buses and HOVs traveling south on I-680 would exit the HOV lane via the new ramp that descends to an at-grade intersection that would be an L-shaped two-way stop-controlled intersection. The vehicles would turn left and cross under I-680 northbound lanes and arrive at the perimeter road at the BART station, via a freeway undercrossing structure. The express buses and HOVs accessing northbound I-680 would also use the structure under the I-680 northbound lanes and enter the freeway on the left-side via the northbound direct on-ramp. This option would not significantly impact the planned Transit-Oriented Development for the Walnut Creek BART Station.

The associated work would include:

- Widening of I-680 to create room in the median for the HOV direct access ramps; this would mostly impact the existing residential developments along the west side of I-680. To minimize right-of-way impacts, new retaining walls would be needed along both the east and west side of I-680.
- Construction of a "U" trench for the HOV direct access ramps connecting to the new access road. The new access road would cross under the northbound lanes of I-680 via a new undercrossing structure and terminate at the BART perimeter road.
- Widening of the three existing undercrossing structures at Ygnacio Valley Road.
- Removal of a portion of the undercrossing structure at Ygnacio Valley Road that carries traffic to westbound SR 24.
- Realignment of the slip on-ramp from Ygnacio Valley Road to southbound I-680.
- Realignment of the loop on-ramp from Ygnacio Valley Road to westbound SR 24.
- Widening of the undercrossing structure at Parkside Drive.
- Relocation of the intersection of Parkside Drive and San Juan Avenue.
- Relocation of Buena Vista Avenue to the west as a result of the freeway widening.

In the development and evaluation of the HOV Direct Connector Ramp option, it was assumed that two future planned HOV lane projects on I-680 would be in place as part of the future baseline. Essentially, these projects would provide the baseline HOV facility on the freeway mainline to which the HOV ramp would be able to connect.

- **Southbound I-680 HOV Lane Gap Closure Project.** This project will close the gap in the southbound HOV lane between the North Main Street interchange and the Livorna Road interchange on I-680. Alternative 1, as described above in Section 6.1.1.1, was assumed for the future baseline.
- **Northbound I-680 HOV Lane Project.** This project proposes to add an HOV lane on I-680 in the northbound direction from the North Main Street Overcrossing north to connect to an existing HOV lane that begins just north of the I-680/SR 242 interchange. Alternative 1 from the Final PSR dated March 2007 was assumed for the future baseline.

This alternative would re-stripe the existing roadway to add a median HOV lane from north of North Main Street to Monument Boulevard without any right-of-way acquisitions. This would require reducing the widths of the left shoulder as well as some of the inside lanes. Widening of the freeway would be included from north of Monument Boulevard to the I-680/SR 242 interchange.

6.1.2 Other Arterial Improvements

Three Other Arterial Improvement Options were also selected for further evaluation by the study TAC and PAC. The goal of these options is to further enhance transit and HOV access between I-680 and the Walnut Creek and Pleasant Hill BART Stations. Some minor refinements were made to the various options after the screening process, and a description of each of these options is provided below.

6.1.2.1 Option 3: Buskirk Avenue Improvements

Buskirk Avenue runs from Monument Boulevard south to Treat Boulevard. As shown in **Figure 6-3**, this option seeks to improve the roadway in a manner consistent with current City of Pleasant Hill plans, through geometric modifications, roadway realignment, and intersection modifications, including transit signal priority, as described below:

- Abandoning the existing S-curve section of Buskirk Avenue between Elmira Lane and Hookston Road.
- Widening the existing two-lane and three-lane roadway segments of Buskirk Avenue, Elmira Lane and Hookston Road to a four-lane segment with two lanes in each direction.
- Removal of the existing all-way-stop-control intersection at Elmira Lane and construction of a smooth curve between Buskirk Avenue and the north end of Elmira Lane.
- Installation of a new traffic signal at the intersection of Elmira Lane and Hookston Road.
- Installation of TSP at all signalized intersections on Buskirk Avenue from Monument Boulevard to Treat Boulevard.

For buses traveling from Monument Boulevard to the Pleasant Hill BART station, improvements to Buskirk Avenue would contribute to slightly faster and more reliable transit travel times. Improvements would remove one all-way stop intersection and improve the alignment of Buskirk Avenue between Mayhew Way and Monument Boulevard. The provision of TSP would reduce the delay to buses at the signalized intersections.

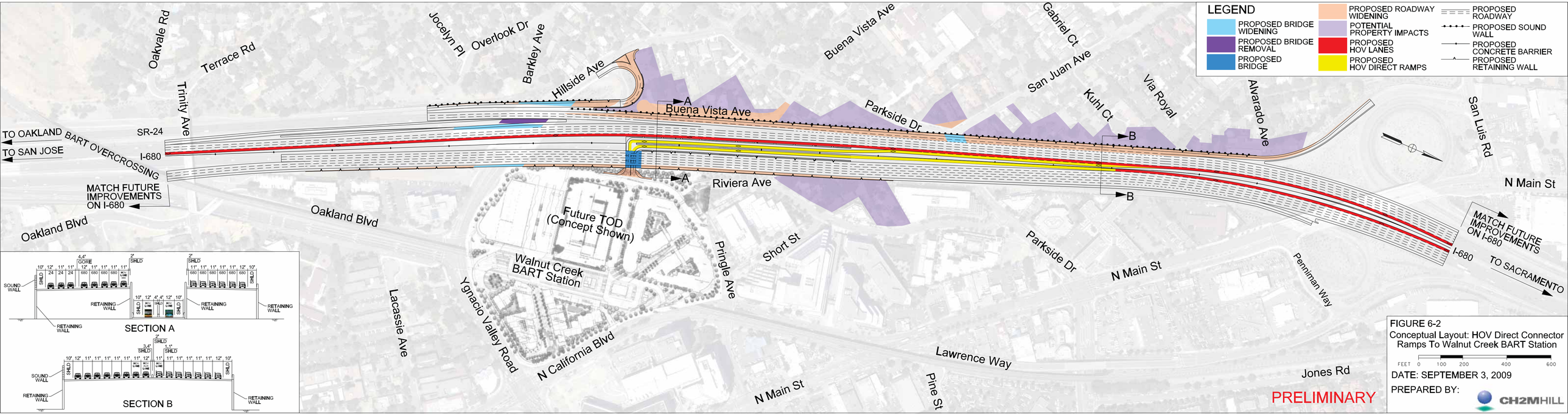


FIGURE 6-2
Conceptual Layout: HOV Direct Connector Ramps To Walnut Creek BART Station

FEET 0 100 200 400 600

DATE: SEPTEMBER 3, 2009

PREPARED BY: CH2MHILL

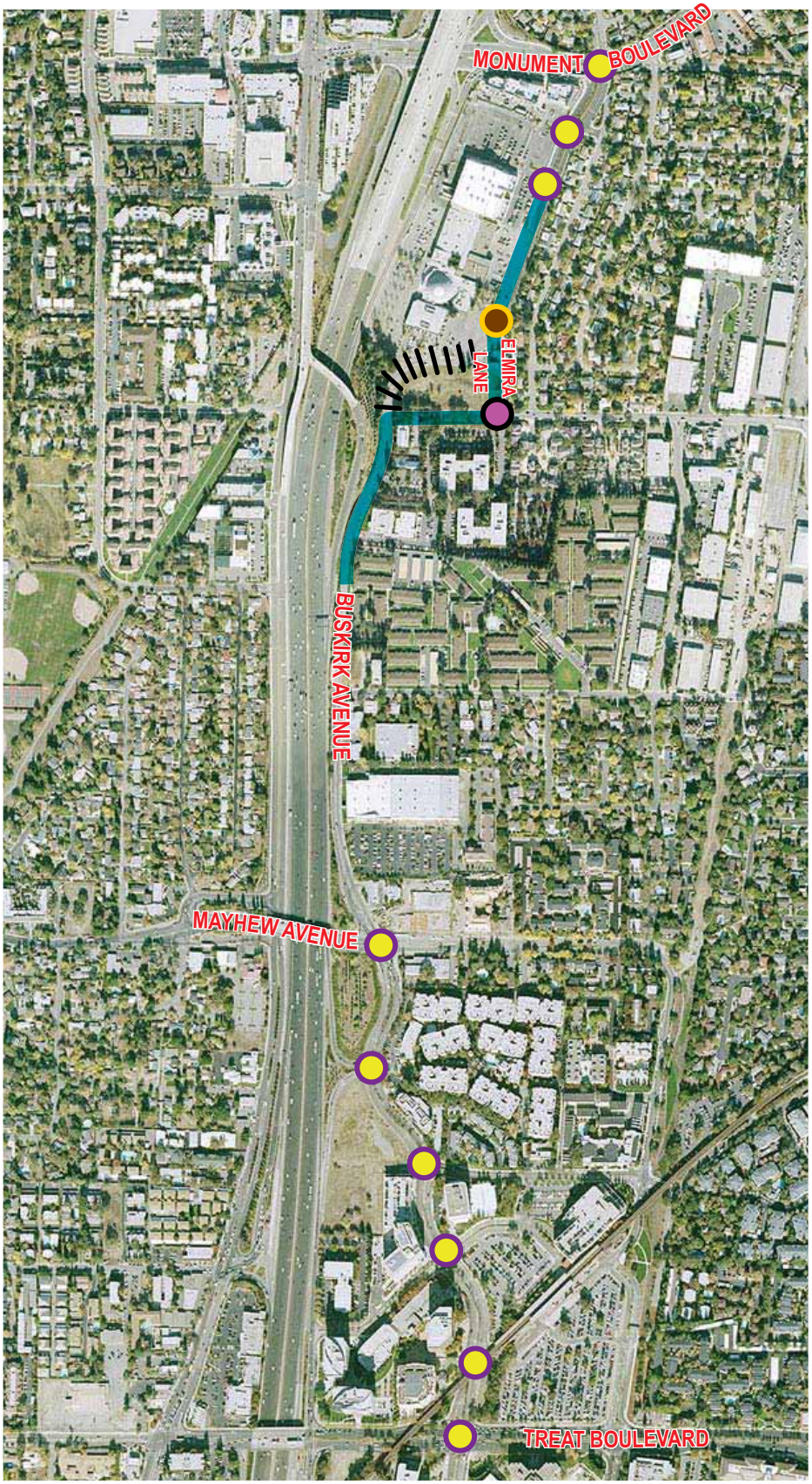


FIGURE 6-3
Option 3: Buskirk Avenue Improvements
I-680 HOV/Express Bus Access Study

6.1.2.2 Option 4: Long Distance Express Bus Consolidation at Walnut Creek BART Station

Currently, a number of long distance express bus routes traveling to and from the north terminate at the Pleasant Hill BART Station, while those traveling to and from the south terminate at the Walnut Creek BART station. As shown in **Figure 6-4**, the proposed routing in this option would consolidate all long distance express bus service at the Walnut Creek BART station. The express buses traveling from the north would be rerouted to exit I-680 via the North Main St. exit and continue on North Main St. toward Walnut Creek BART Station. In the opposite direction, express buses departing from Walnut Creek BART Station would travel along North Main St. and enter I-680 northbound through the Lawrence Way entry. TSP would also be implemented at the following intersections between I-680 and Walnut Creek BART to improve transit travel times:

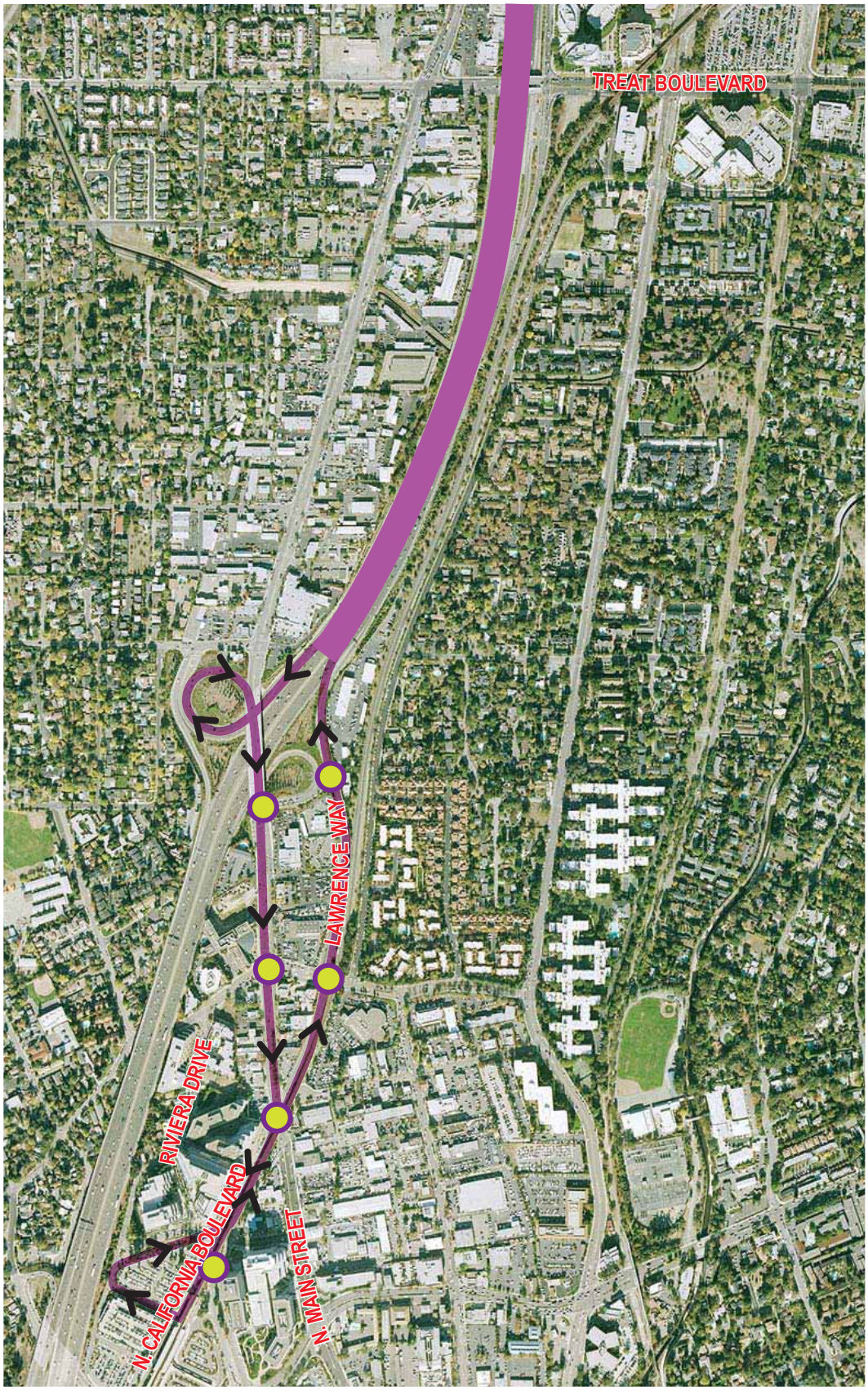
- North Main St./Penniman Way
- North Main St./Parkside Dr.
- North California Blvd./Pringle Ave.

By consolidating the long distance express bus service at Walnut Creek BART, a regional bus hub would be created that brings the north-oriented bus service (such as those from Solano County) together with the south-oriented bus service (such as those serving San Ramon/Bishop Ranch), allowing better transfers between these services. Ability to transfer to a BART station would be preserved for all express bus lines. However, those coming from the north may find fewer seats available on the BART trains at the Walnut Creek BART Station, as compared to the Pleasant Hill BART Station.

6.1.2.3 Option 5: Transit Signal Priority/Queue Jump Lanes

For this option, TSP) and/or queue jump lanes would be installed on the intersections between I-680 and the Pleasant Hill and Walnut Creek BART stations. These improvements would be to the surface streets that express buses use to access the BART stations and would help lower travel times and increase service reliability. As illustrated in **Figure 6-5**, fourteen intersections would be affected by Alternative 5. Of these, three would include implementation of TSP and queue jump lanes as described below:

- North Main Street-Sunnyvale Avenue/I-680 southbound exit—implement TSP; install bus queue jump lane on southbound off-ramp approach by restriping the approach to allow buses to turn left from the right lane. A "bus only" start-up phase would allow buses to cross the intersection before the adjacent queue starts.
- North Main Street/Geary Road—implement TSP; install bus queue jump lane on the southbound approach by re-striping the existing right-turn-only lane to permit buses to travel through the intersection. A "bus only" start-up phase would allow buses to cross the intersection before the adjacent left turn movement starts.
- Oak Road/Treat Boulevard—implement TSP; install bus queue jump lane on southbound by modifying the island to permit buses to use the existing right-turn-only lane to reach the stop line. A "bus only" start-up phase would allow buses to cross the intersection before the adjacent left turn movement starts.



LEGEND

PROPOSED ROUTE

TRANSIT SIGNAL PRIORITY

FIGURE 6-4
Option 4: Long Distance Express Bus Consolidation at Walnut Creek BART
I-680 HOV/Express Bus Access Study

FIGURE 6-5
Option 5: Transit Signal Priority/ Queue Jump Lanes
I-680 HOV/Express Bus Access Study

Only TSP would be implemented at the following eleven locations:

- Buskirk Avenue – northbound I-680 off-ramp/Treat Boulevard
- Jones Road/Treat Boulevard
- Oak Road/Wayne Court
- Oak Road/BART Entrance
- Oak Road/Jones Road
- North Civic Drive/Parkside Drive
- North Broadway/Parkside Drive
- Lawrence Way/Parkside Drive
- North Main Street/Parkside Drive
- North California Boulevard/Lawrence Way/North Main Street
- North California Boulevard/Pringle Avenue

6.2 Evaluation Results

Each of the options was evaluated based on a wide range of evaluation criteria, which were described in Section 4 of this report. The results of the option screening process using the screening criteria were described above in Sections 5.3.8 and 5.3.9. This subsection presents a summary of the application of the prioritization criteria to the options that were retained for further evaluation after the screening process. A discussion of costs is provided in Section 6.3.

6.2.1 HOV/Transit System Access and Connectivity

The assessment of HOV/transit connectivity focused on whether each option would increase access to and connectivity with the existing HOV lanes on I-680, with the Walnut Creek/Pleasant Hill BART Stations, and between express bus routes. The option with the greatest impact on HOV/transit connectivity was determined to be Option 1 - Southbound I-680 HOV Lane Gap Closure, which would "fill in" the existing HOV lane gap on southbound I-680, which would be used by both HOVs and express buses. The next level of impact would result from Option 2 – I-680 HOV Direct Connector Ramps to Walnut Creek BART, which would also serve both HOVs and express buses; however, it would serve fewer HOVs than Option 1 since many HOVs do not exit the freeway to stop at a BART station.

A lower-level, but still positive, impact on HOV/transit connectivity would result from the increased opportunities for express bus transfers in Option 4 – Long Distance Express Bus Consolidation. A small increase in bus access would result from Option 5 - Transit Signal Priority/Queue Jump Lanes, which would only impact buses on the local streets. Option 3 – Buskirk Avenue Improvements would have a negligible impact on HOV/transit connectivity.

6.2.2 Transit Operations

Transit and HOV operations would both be greatly improved with the implementation of Option 1 - Southbound I-680 HOV Lane Gap Closure. The next level of impact would result from Option 2 – I-680 HOV Direct Connector Ramps, which would provide a more direct connection from the I-680 HOV lanes to the Walnut Creek BART station, and would make travel times more reliable for the transit operators. Option 4 – Long Distance Express Bus

Consolidation would improve transfer opportunities between express buses and would streamline transit operations. Option 5 - Transit Signal Priority/Queue Jump Lanes would improve transit operations through congested traffic signals. Option 3 – Buskirk Avenue Improvements would have a negligible impact on transit operations.

6.2.3 Traffic Operations

The evaluation of traffic operations focused on five performance measures. Four of the performance measures were assessed for the freeway-based RM 2 Investment Options: HOV delay, HOV/bus travel time, mode shift/increase in HOV throughput, and freeway operation based on weaving. Two of the performance measures were assessed for the arterial-based options: HOV/bus travel time and intersection delay.

The results of the traffic operations evaluation are summarized in **Table 6-1** and discussed below. The evaluation of Option 1 - Southbound I-680 HOV Lane Gap Closure is based directly on the results presented in the Traffic Operations report prepared as part of the Draft PSR by Caltrans.

6.2.3.1 Peak Hour HOV Delay Reduction

Option 1 - Southbound I-680 HOV Lane Gap Closure is estimated to reduce the total freeway hours of delay incurred by HOVs within the segment of I-680 from SR 242 to Livorna by over 50 percent during both the AM and PM peak hours.

Option 2 – I-680 HOV Direct Connector Ramps to Walnut Creek BART Perimeter Road would provide only a slight reduction in overall freeway HOV delay by eliminating the need for HOVs to weave through the congested mixed flows when exiting or entering the freeway.

6.2.3.2 HOV/Bus Travel Time Reduction

Option 1 - Southbound I-680 HOV Lane Gap Closure is estimated to reduce average HOV travel time on I-680 from SR 242 to Livorna by approximately 50 percent (from 27 minutes to 13.5 minutes in the AM peak hour, and 17 to 9 minutes in the PM peak hour).

For HOV trips originating from or destined to the north on I-680, Option 2 – I-680 HOV Direct Connector Ramps to Walnut Creek BART Perimeter Road could reduce travel times for HOVs and express buses by 4 minutes by eliminating the need for HOVs and express buses to weave through the congested mixed-flow lanes when exiting or entering the freeway, and by eliminating travel on local streets.

Option 3 - Buskirk Avenue Improvements would improve traffic flow along Buskirk Avenue and provide signal priority for transit vehicles. However, given the relatively light traffic flows and congestion level on this route, these improvements are expected to reduce transit travel times by only 1 minute.

By eliminating the need to first stop, and possibly transfer, at the Pleasant Hill BART Station, Option 4 – Long Distance Express Bus Consolidation could reduce the travel time for those originating from or destined to points north on I-680 by approximately 15 minutes.

Option 5 – Transit Signal Priority/ Queue Jump Lanes could reduce bus travel times on the affected segments by approximately 1 minute.

TABLE 6-1
Traffic Operations Performance Measures

		Performance Measures									
		Peak Hour Freeway HOV Delay Reduction (Hours of Delay)		HOV/Bus Travel Time Reduction (Minutes/Veh)		Mode Shift/Increase in HOV Throughput		Freeway Operation (Reduction of Weaving HOVs) (Vehicles)		Intersection Delay (sec/veh)	
	Option	AM	PM	AM	PM	AM	PM	AM (SB off)	PM (NB on)	AM	PM
Regional Measure 2 Investments[1]											
1	SB I-680 HOV Lane Gap Closure[3]	285	160	14	8	15%-20%	2%-3%	Negligible	Negligible		
2	I-680 HOV Direct Connector Ramps to Walnut Creek BART Perimeter Rd.	4	8	2	3			220	240		
Other Arterial Improvements[2]											
3	Buskirk Avenue Improvements[4]			2	2	Negligible	Negligible			-2	-4
4	Long Distance Express Bus Consolidation at Walnut Creek BART			13	16	Negligible	Negligible			< 1	< 1
5	Transit Signal Priority/Queue Jump Lanes					Negligible	Negligible				
	SB I-680 to Pleasant Hill BART			1	1					< 1	< 1
	Pleasant Hill BART to Walnut Creek BART			1	1					1-2	1-2
	SB I-680 to Walnut Creek BART			0	0					< 1	< 1

Notes:
1 For RM 2 Investments, analysis year is 2035 (consistent with the SB I-680 HOV Gap Closure Project Draft PSR). Applicable performance measures are HOV freeway delay reduction, HOV travel time saving, increase in HOV throughput, and HOV freeway weaving reduction.
2 For Other Arterial Improvements, analysis based on existing conditions. Applicable performance measures are HOV/bus travel time saving, mode shift, and intersection delay impact.
3 For Option 1, results derived from SB I-680 HOV Lane Gap Closure Project Draft PSR - Traffic Operations Analysis memorandum.
4 For Option 3, intersection delay savings are a result of the widening to 4 lanes.

Source: DKS Associates, 2009

6.2.3.3 Mode Shift/Increase in HOV Throughput

Option 1: The analysis presented in the Southbound I-680 HOV Lane Gap Closure PSR (Caltrans, 2009) suggests that the HOV demand mode share along southbound I-680 would increase by less than 2 percent in the AM and PM peak hours. The analysis also indicates that the HOV lane gap closure project would result in an increase in the HOV throughput of 15 percent to 20 percent in the AM peak, and 2 percent to 3 percent in the PM peak.

Option 2 – I-680 HOV Direct Connector Ramps to Walnut Creek BART Perimeter Road is not expected to have a measurable impact on HOV mode share or throughput.

With only a limited reduction in bus travel times, Option 3 – Buskirk Avenue Improvements and Option 5 – Transit Signal Priority/ Queue Jump Lanes would be expected to have a negligible impact on transit mode share.

While Option 4 - Express Bus Consolidation at Walnut Creek BART Station would have a significant impact on travel time, the number of buses and travel market (from Solano to southern Contra Costa and beyond) is limited. Therefore this alternative is also expected to have a negligible impact on overall mode share in the corridor.

6.2.3.4 Freeway Operation (Reduction of Weaving HOVs)

Option 1 - Southbound I-680 HOV Lane Gap Closure would not necessarily affect the weaving of HOVs, but it would improve freeway operations as measured by increased vehicle throughput at the Livorna bottleneck. According to the traffic analysis conducted for the Draft PSR, the total throughput would increase by up to 3 percent.

Option 2 – I-680 HOV Direct Connector Ramps to Walnut Creek BART Perimeter Road would reduce the need for HOVs to weave through the congested mixed-flow lanes when exiting or entering the freeway. In turn, this reduction in weaving would improve mainline operations in the segments where this weaving would otherwise occur.

6.2.3.5 Intersection Delay (Seconds per Vehicle)

For each of the arterial-based options, the transit signal priority component could impact intersections providing benefit to movements that run concurrent with the TSP phase, while having a negative impact on other movements. Option 4 – Long Distance Express Bus Consolidation would also impact intersection operations by reducing the number of buses on streets around the Pleasant Hill BART station and increasing the number on streets around the Walnut Creek BART station. However, because the number of buses affected is low (4 to 6 per hour), and not all buses will require activation of the TSP, the impact on intersection operations is expected to be negligible (an average of less than 1 second per vehicle) for all of the arterial-based options.

6.2.4 Environmental Impacts

The assessment of environmental impacts focused on the potential impacts to air quality, noise, and aesthetics. Potential impacts to natural resources were initially assessed, but no impacts were identified for any of the options.

6.2.4.1 Air Quality/Noise

The qualitative assessment of air quality and noise impacts were based upon whether the traffic operations analysis predicted reduced delay or travel time, which is roughly equated

with less stop-and-go driving and smoother travel speeds. Reduced braking and acceleration due to reduced stop-and-go driving and smoother travel speeds would result in lower air quality emissions and reduced noise impacts. Option 1 - Southbound I-680 HOV Lane Gap Closure would have the greatest impact on overall delay and travel time, and would therefore have the most positive impact on air quality and noise. Option 2 - I-680 HOV Direct Connector Ramps to Walnut Creek BART Perimeter Road would have some impact on weaving, which would smooth traffic flow, resulting in a positive, but lesser, impact on air quality and noise. Option 3 – Buskirk Avenue Improvements would smooth traffic flow and improve air quality and noise impacts for this section of Buskirk Avenue. The remaining two options would be expected to have a negligible impact on air quality and noise.

6.2.4.2 Aesthetics

Impacts to aesthetics or visual impacts were assessed for each option. Only Option 2 - I-680 HOV Direct Connector Ramps to Walnut Creek BART Perimeter Road was identified as having impacts in this area. There would be some visual impact as a result of widening the freeway and constructing additional retaining walls. Since the HOV direct connector ramps go below the freeway, the impacts are expected to be relatively minor.

6.2.5 Right-of-Way Impacts

The option with the greatest potential to have significant right-of-way impacts is Option 2 - I-680 HOV Direct Connector Ramps to Walnut Creek BART Perimeter Road. This improvement would require widening the freeway outside of the existing right-of-way. It is too early to ascertain the exact nature of the impacts, but parcels that have a high likelihood of being impacted were identified and are illustrated in **Figure 6-2**. Most of the potentially impacted parcels are on the west side of I-680, and include 20 multi-family parcels, 6 single-family parcels, and 1 common area/miscellaneous parcel. The potential impacts on the east side of I-680 are less intrusive with 3 multi-family parcels and 3 single-family parcels potentially impacted. In all, 23 multi-family, 9 single-family, and 1 common area/miscellaneous parcels could see some impact from the project, for a total for 33 parcels.

Option 3 – Buskirk Avenue Improvements would likely have the need to purchase some right-of-way and impact one or more parcels.

The remaining options would not require additional right-of-way.

6.3 Cost Estimates

For each option, order-of-magnitude capital cost estimates were prepared. These are reported in current (2009) dollars. Right-of-way costs are not included in this cost estimate. Potential impacts to right-of-way were incorporated into the assessment of environmental impacts. A summary of the cost estimate for each option is provided in this section. More details on each cost estimate are provided in **Appendix B**.

6.3.1 Option 1: Southbound I-680 HOV Lane Gap Closure Project

The cost estimate for the Southbound I-680 HOV Lane Gap Closure Project was obtained from the Draft PSR (Caltrans, 2009). Total construction costs in current dollars, not including the cost of right-of-way, is estimated to be approximately $45 million.

Table 6-2 below provides a summary of the cost breakdown of the major item categories of the cost estimate.

TABLE 6-2
Total Estimated Construction Cost (2009 dollars): Option 1 – Southbound I-680 HOV Lane Gap Closure Project

Item Category	Estimated Cost (thousands)
I. Roadway Items	$40,543
II. Structure Items	$4,704
Total	**$45,247**

Source: Caltrans, 2009

6.3.2 Option 2: I-680 HOV Direct Connector Ramp to Walnut Creek BART Station Perimeter Road

An order-of-magnitude estimate of the probable construction cost for the HOV direct connector ramp was prepared in a format similar to that used on Caltrans PSRs. The most notable cost items were the U-trench and I-680 undercrossing structure associated with the HOV direct connector ramps, as well as bridge and roadway widening, and the complex construction staging associated with these elements. The outside retaining walls also added significant costs due to their heights and close proximity to adjacent residential development. The anticipated total cost of construction was estimated to be approximately $104 million. **Table 6-3** below provides a summary of the cost breakdown of the major item categories of the cost estimate.

TABLE 6-3
Total Estimated Construction Cost (2009 dollars): Option 2 – I-680 HOV Direct Connector Ramp to Walnut Creek BART Station Perimeter Road

Item Category	Estimated Cost (thousands)
I. Roadway Items	$92,246
II. Structure Items	$12,009
Total	**$104,255**

6.3.3 Option 3: Buskirk Avenue Improvements

An order of magnitude estimate has been developed by the City of Pleasant Hill for the proposed roadway improvements along Buskirk Avenue. The anticipated total cost of construction was estimated to be approximately $7.1 million, including some TSP improvements.

6.3.4 Option 4: Long Distance Express Bus Consolidation at Walnut Creek BART Station

An order of magnitude estimate was developed of the probable construction cost for the proposed consolidation of long distance express bus service at the Walnut Creek BART Station. No capital or construction costs were identified for the consolidation itself, but approximately $81 thousand in construction costs were identified for TSP improvements included with this option.

6.3.5 Option 5: Transit Signal Priority/Queue Jump Lanes

An order of magnitude estimate was developed of the probable construction cost for the proposed TSP and queue jump lane locations. The anticipated total cost of construction was estimated to be approximately $0.2 million.

The cost estimates for both Options 3 and 5 assumed that six buses would be equipped with TSP transmitters. If the entire County Connection fleet were to be equipped with TSP transmitters, the cost would be approximately $175,000. This additional cost, if added, would not result in a noticeable change in the evaluation scoring and no change in the final prioritization.

7.0 Prioritization of Options

A structured decision-making process was used to evaluate the options identified. CH2M HILL used Criterium® DecisionPlus® 3.0, a commercially available software tool, to conduct the decision analysis.

In this process, the evaluation criteria were weighted to reflect the relative importance of each criterion. The weighting of the evaluation criteria, which was described in Section 4 of this report, was developed in conjunction with the study TAC and PAC and is shown in **Table 7-1.**

TABLE 7-1
Evaluation Criteria and Weighting

Evaluation Criteria	Weighting
HOV/Transit Connectivity	25
Transit Operations	20
Traffic Operations	10
Environmental Impacts	15
Right-of-Way Impacts	10
Capital Cost	20
Total Criteria Weights	**100**

Figure 7-1 graphically depicts the decision process with the goal of selecting an option, the six evaluation criteria, and the options under consideration.

The prioritization first examined the two Regional Measure 2 investment options, and then compared all five options. The scoring conducted for the prioritization was conducted with and without cost as a criterion.

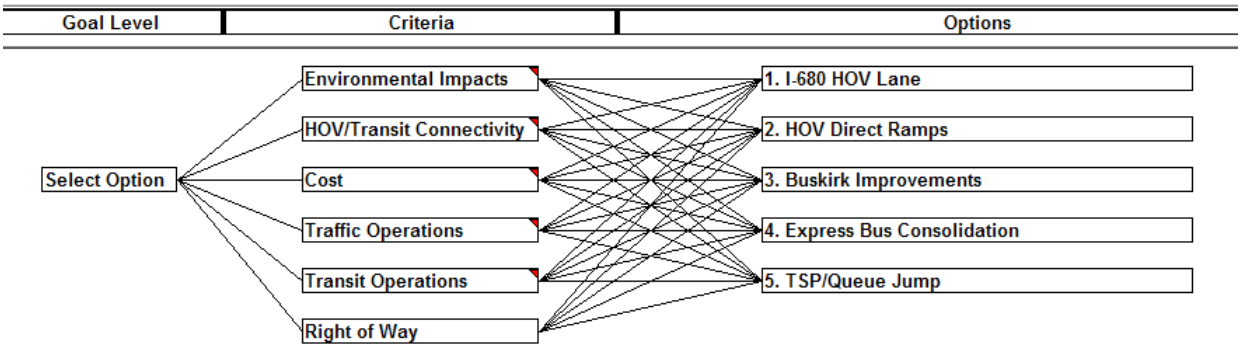


FIGURE 7-1
Decision Process Flow Diagram

7.1 Overall Evaluation Scores

Based on the evaluation presented in Section 6.2 of this report, the assessment of each of the evaluation criteria was converted to a 1-to-5 scale for input into the decision analysis tool. A score of "5" indicates the most beneficial impact, and a "1" indicates the least beneficial impact. The assignment of scores for each option and criteria (except cost) is provided in **Table** 7-**2**. Construction cost estimates were input directly, and did not need to be converted to a scale.

TABLE 7-2
Evaluation Scores by Criteria and Option

	Options				
Evaluation Criteria	**1. SB I-680 HOV Lane Gap Closure**	**2. I-680 HOV Direct Ramps**	**3. Buskirk Roadway Improvements**	**4. Express Bus Consolidation**	**5. Traffic Signal Priority/ Queue Jump Lanes**
HOV/Transit Connectivity	5	4	2	3	3
Transit Operations	5	4	3	3	2
Traffic Operations	5	3	2	1	1
Environmental Impacts	5	4	2	3	3
Right-of-Way Impacts	5	1	3	5	5
Capital Cost (million $)	45.3	104.3	7.1	0.08	0.24

Note: A score of "5" indicates the most beneficial impact, and a "1" indicates the least beneficial impact.

7.2 Prioritization of Regional Measure 2 Investment Options

Using the structured decision-making process, a score was assigned to each of the two Regional Measure 2 Investment Options based on the evaluation performed for each of the criteria identified. The score developed does not have an intrinsic value; rather, it is a measure for comparison purposes only. The relative scores depicted in **Figure 7-2** are based on all of the criteria, and the relative scores depicted in **Figure 7-3** do not include cost as a criterion.

Both with and without cost as a criterion, Option 1 – Southbound I-680 HOV Lane Gap Closure Project, results in a markedly higher score than Option 2 – I-680 HOV Direct Connector Ramps to the Walnut Creek BART Station Perimeter Road. Please note that the sets of scores are not directly comparable between the two figures because of the normalization that occurs in the software depending upon the number of criteria and their relative weighting.

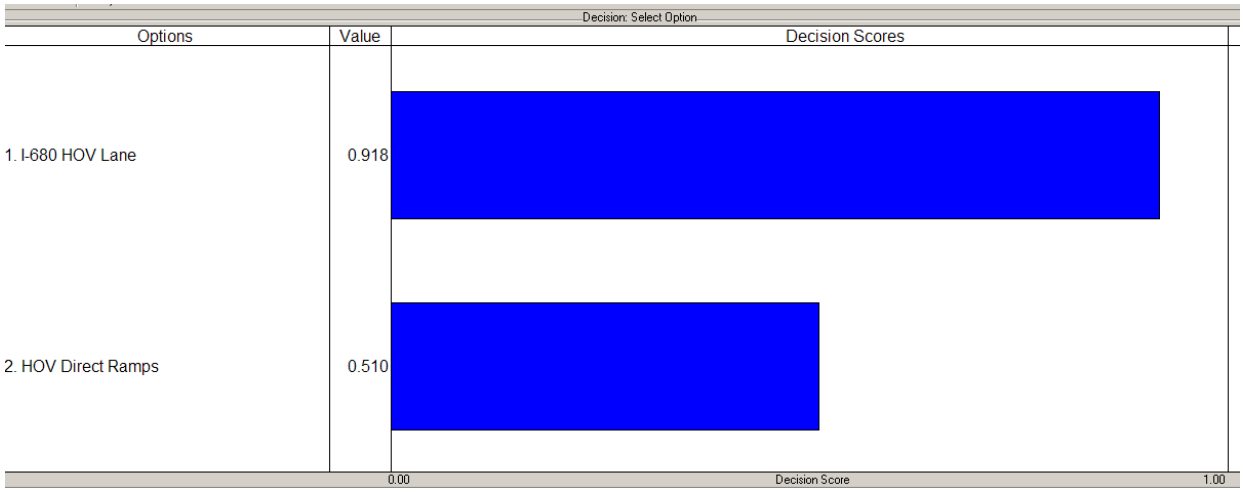


FIGURE 7-2
Prioritization of RM 2 Investment Options with Cost

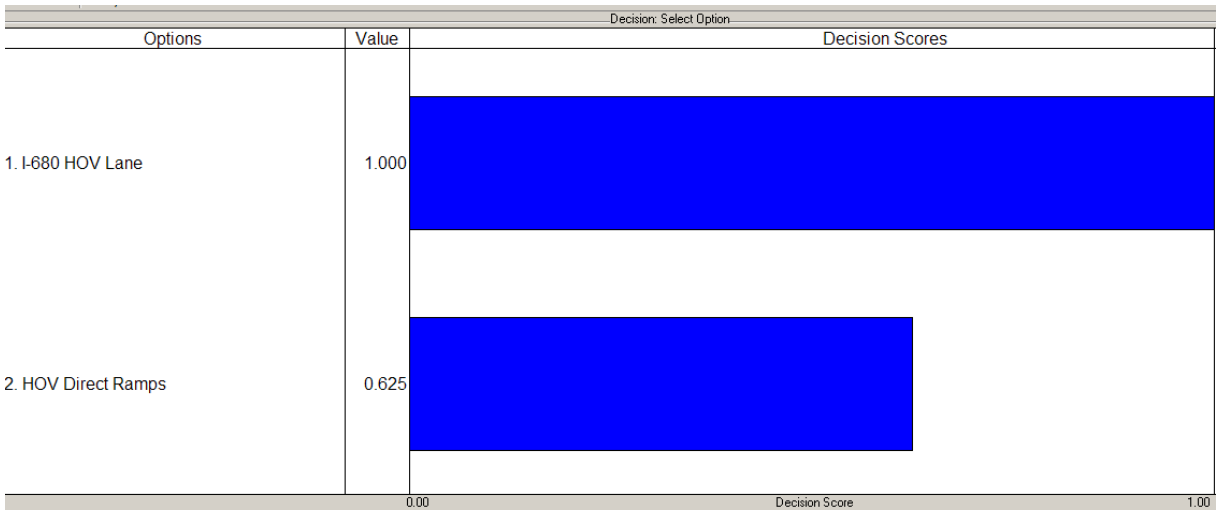


FIGURE 7-3
Prioritization of RM 2 Investment Options without Cost

Note: The sets of scores are not directly comparable between Figures 7-2 and 7-3 because of the normalization that occurs in the software depending upon the number of criteria and their relative weighting.

To assess the relative importance of the contribution of each of the evaluation criteria, a breakdown is provided in **Figure 7-4**, in which cost is included, and **Figure 7-5**, in which cost is not included. Option 1, the I-680 Southbound HOV Lane Gap Closure Project, gains consistently from all criteria.

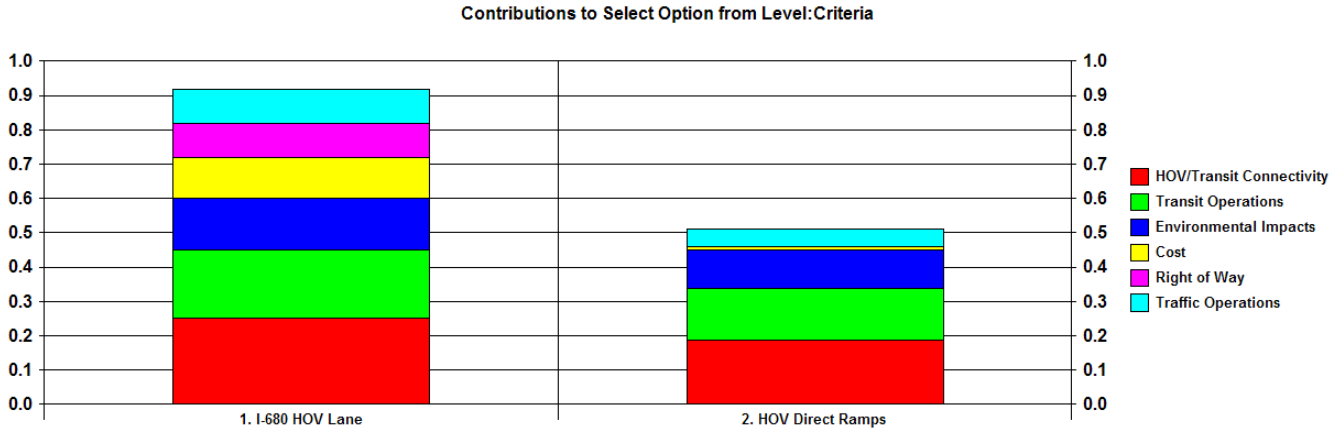


FIGURE 7-4
Contributions to Scores by Criteria with Cost – RM 2 Investment Options

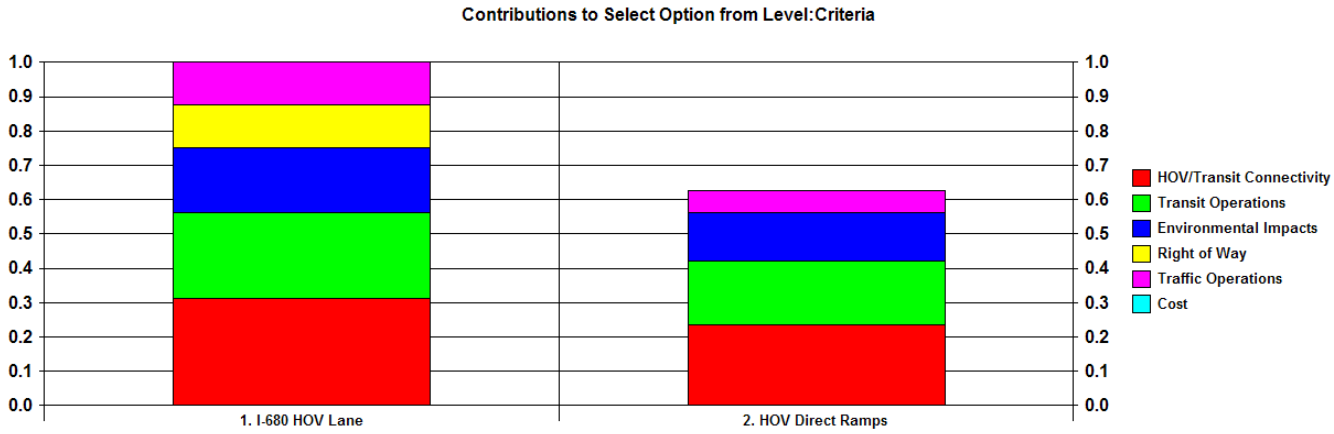


FIGURE 7-5
Contributions to Scores by Criteria without Cost – RM 2 Investment Options

7.3 Prioritization of All Options

All five of the identified options were next evaluated using the structured decision-making process. Similar to the process used for the RM 2 Investment Options, a score was developed based on the evaluation performed for each of the criteria identified. This score in only applicable for the comparison described here. Scores do not have an intrinsic value and cannot be compared across different sets of evaluations. The relative scores depicted in **Figure 7-6** are based on all of the criteria, and the relative scores depicted in **Figure 7-7** do not include cost as a criterion.

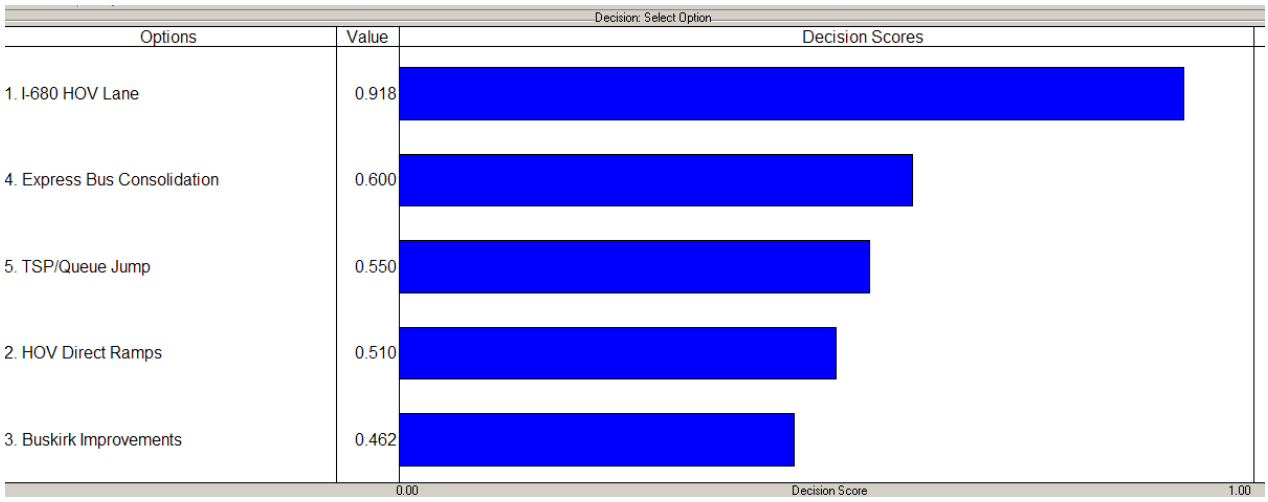


FIGURE 7-6
Prioritization of All Options with Cost

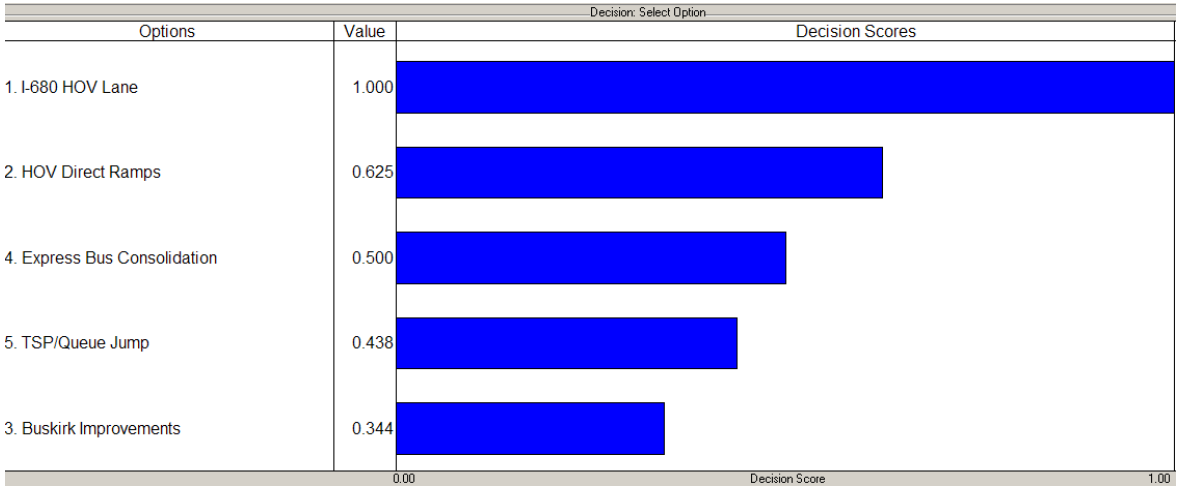


FIGURE 7-7
Prioritization of All Options without Cost

With cost included as a criterion, Option 1 – Southbound I-680 HOV Lane Gap Closure Project scores the highest. The scores for Options 2, 4 and 5 are grouped into a second tier of scores, with Option 3, Buskirk Avenue Improvements, resulting in the lowest score. When cost is removed as a criterion, the ranking of the options by score does not change, but there is a greater differentiation between Option 2- HOV Direct Connector Ramps to the Walnut Creek BART Station Perimeter Road and the arterial-based options.

Figures 7-8 and **7-9** illustrate the contributions of the various criteria to each option's score, with and without cost. Option 1 – Southbound I-680 HOV Lane Gap Closure Project gains consistently from all criteria. Option 2 – HOV Direct Connector Ramps to the Walnut Creek BART Station Perimeter Road, gains little from the improvements to Traffic Operations and, because of the larger Environmental Impact, gains very little from that criterion. As can be seen, the three arterial-based options (Options 3 through 5) received contributions primarily from being low cost options, although Options 4 and 5 gain considerably from the Transit Operations and HOV/Transit Connectivity.

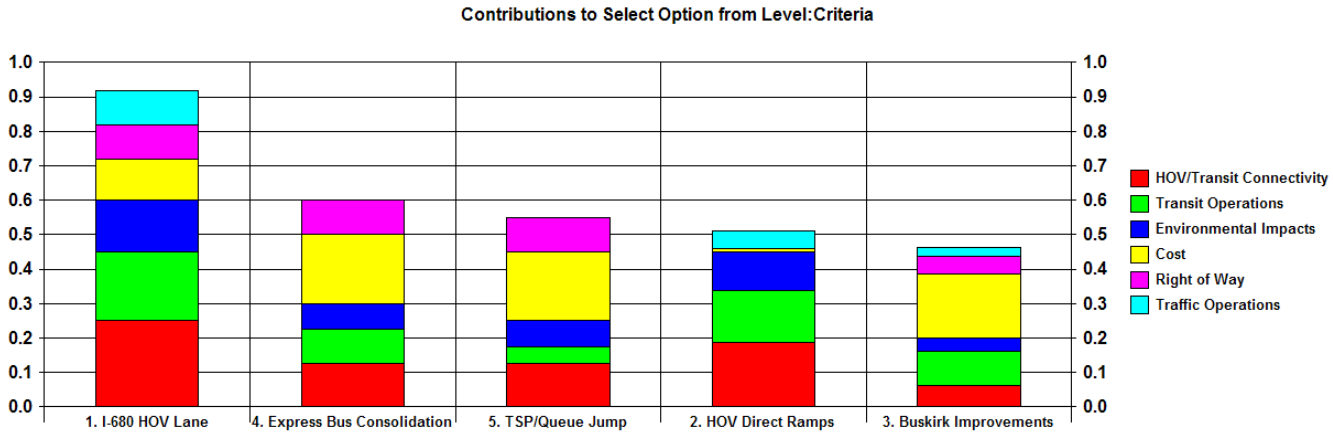


FIGURE 7-8
Contributions to Scores by Criteria with Cost – All Options

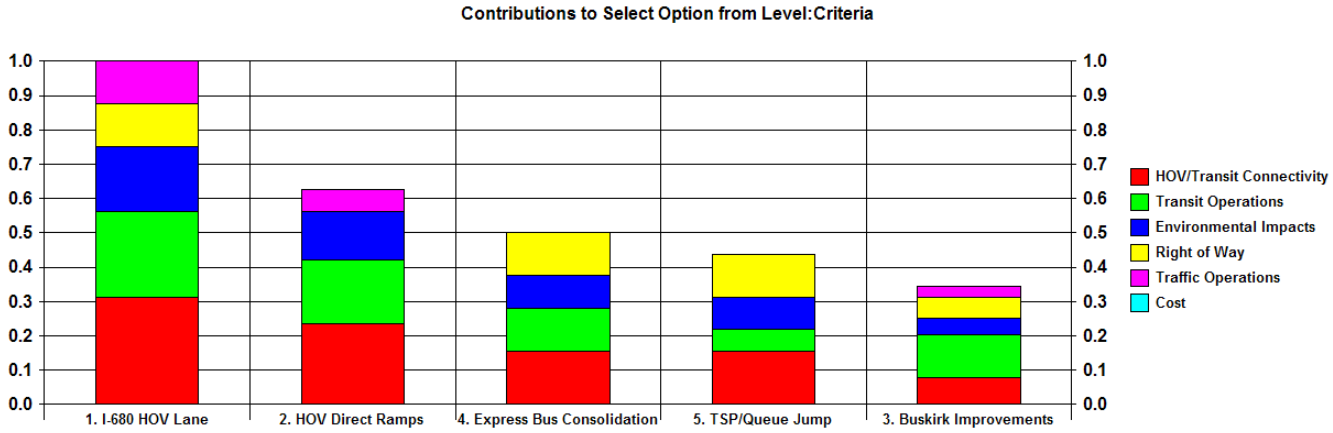
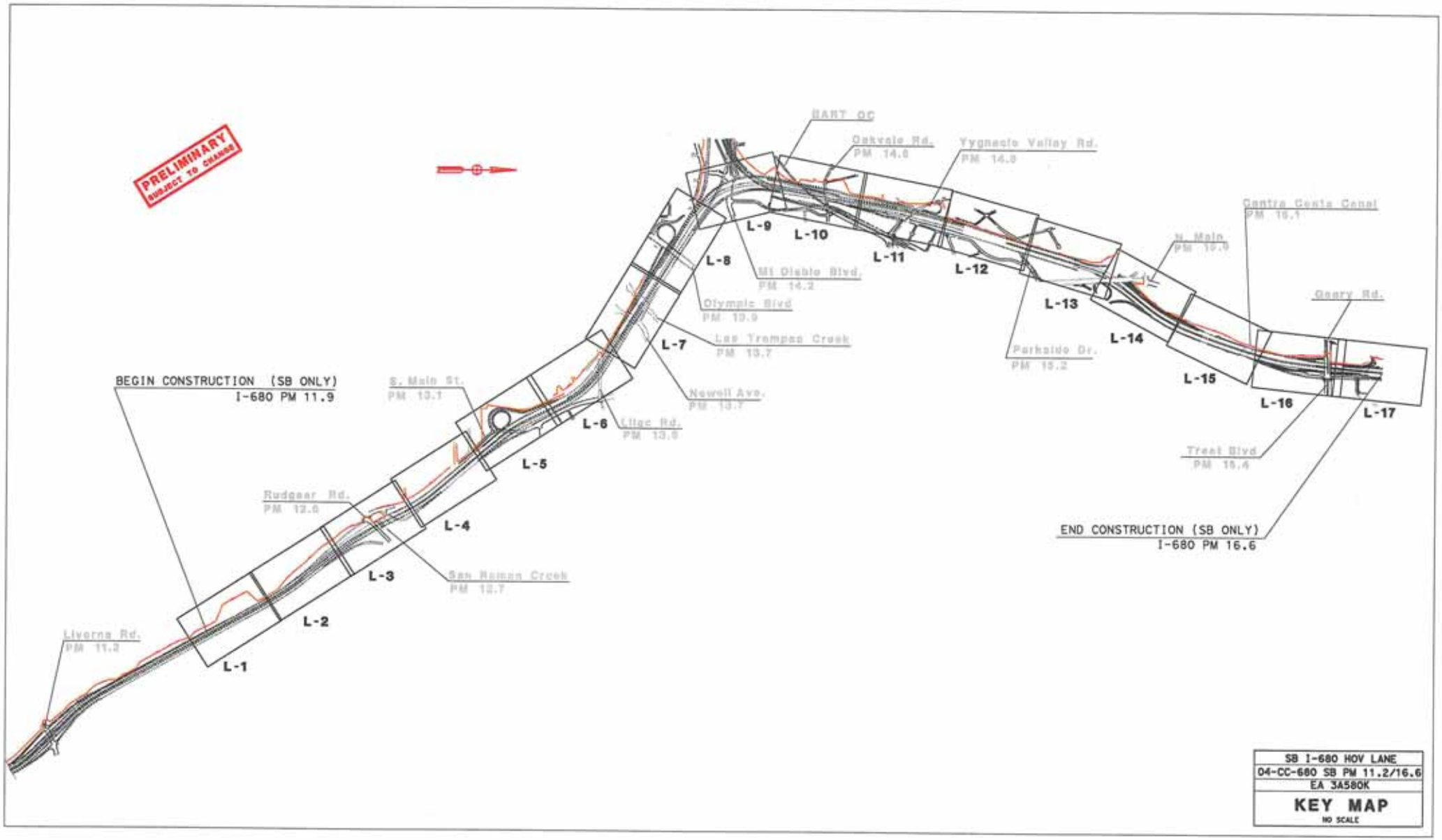


FIGURE 7-9
Contributions to Scores by Criteria without Cost – All Options

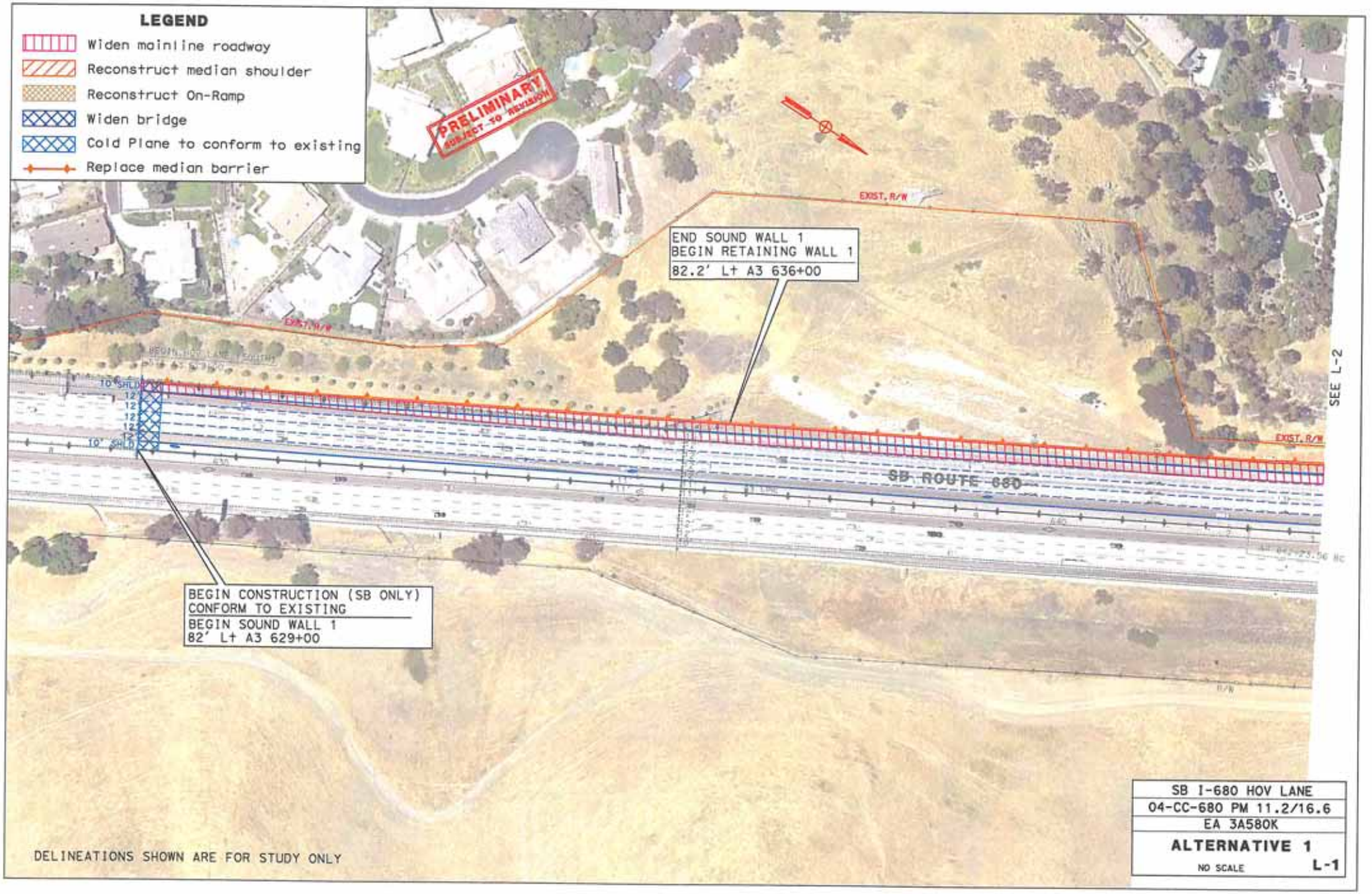
8.0 Recommendation for RM 2 Investment Decision

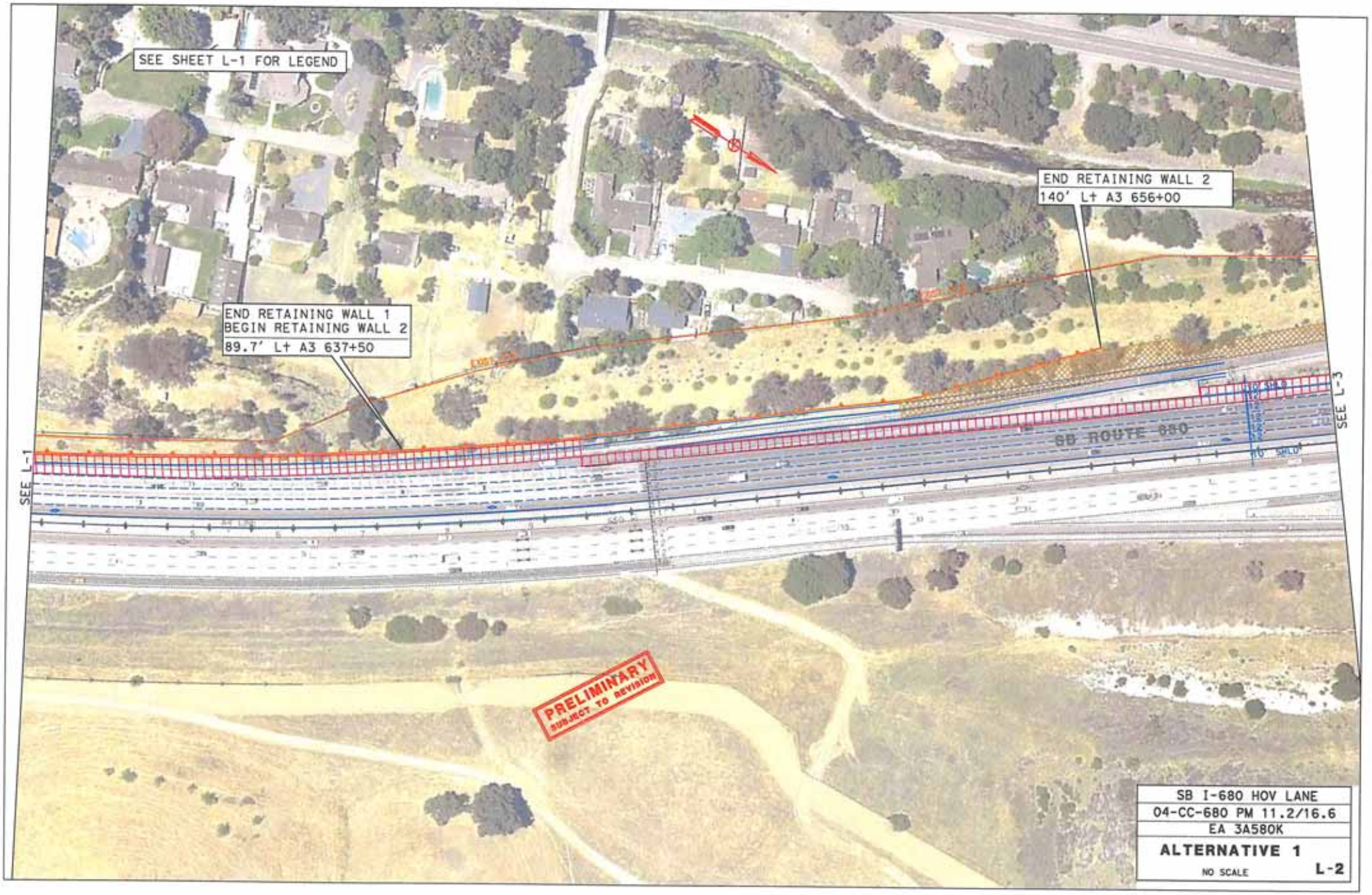
TRANSPAC, CCTA and County Connection recommend that **Option 1—Southbound I-680 HOV Lane Gap Closure Project** receives the available RM 2 funding. This conclusion was reached after evaluating the five options that were developed and closely reviewed by the Study TAC and PAC. Two of these options were identified as RM 2 Investment Options, and three Other Arterial Options were also examined.

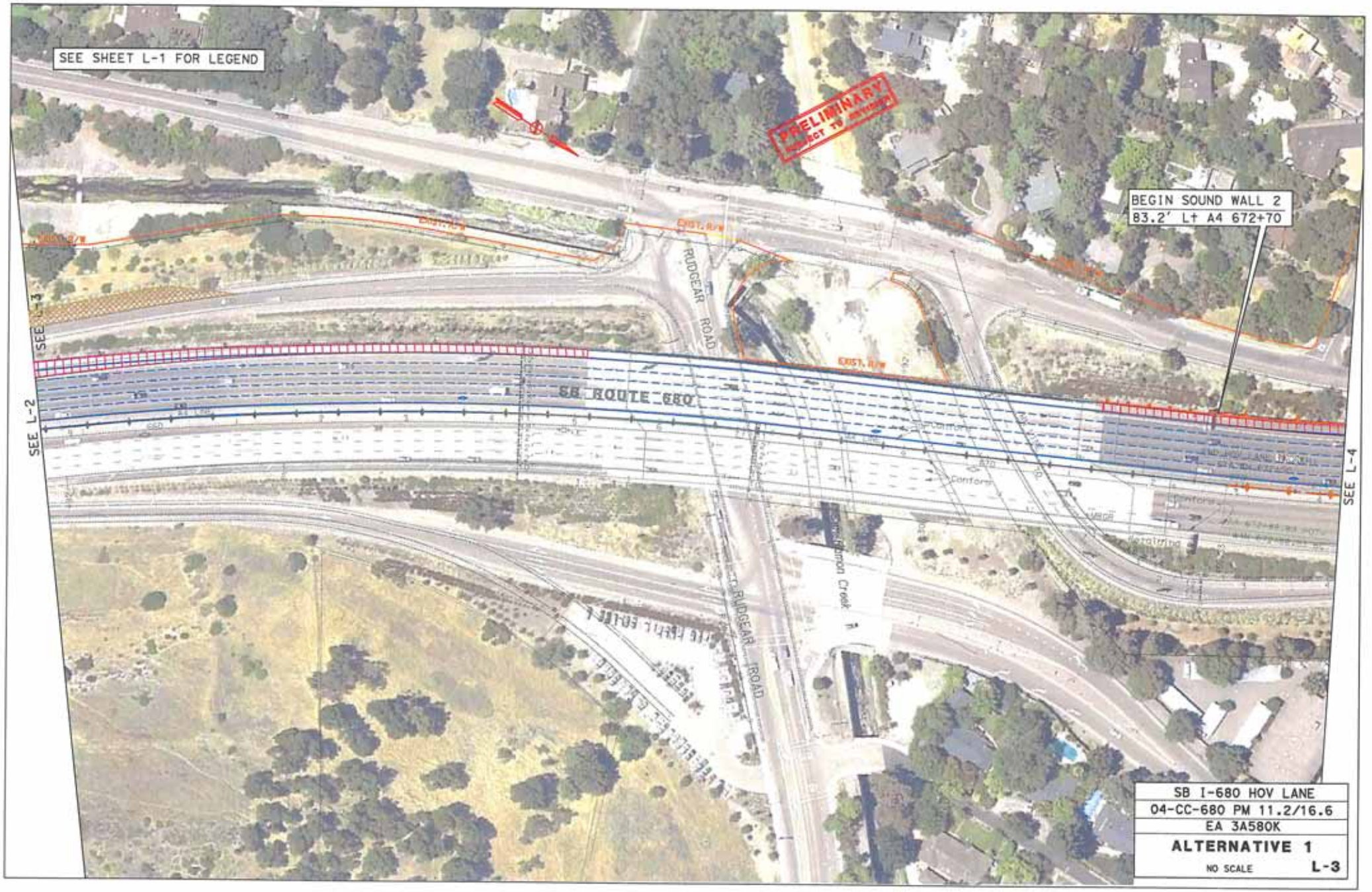
Appendix A
Southbound I-680 HOV Lane Gap Closure Project – Conceptual Drawings for PSR Alternative 1



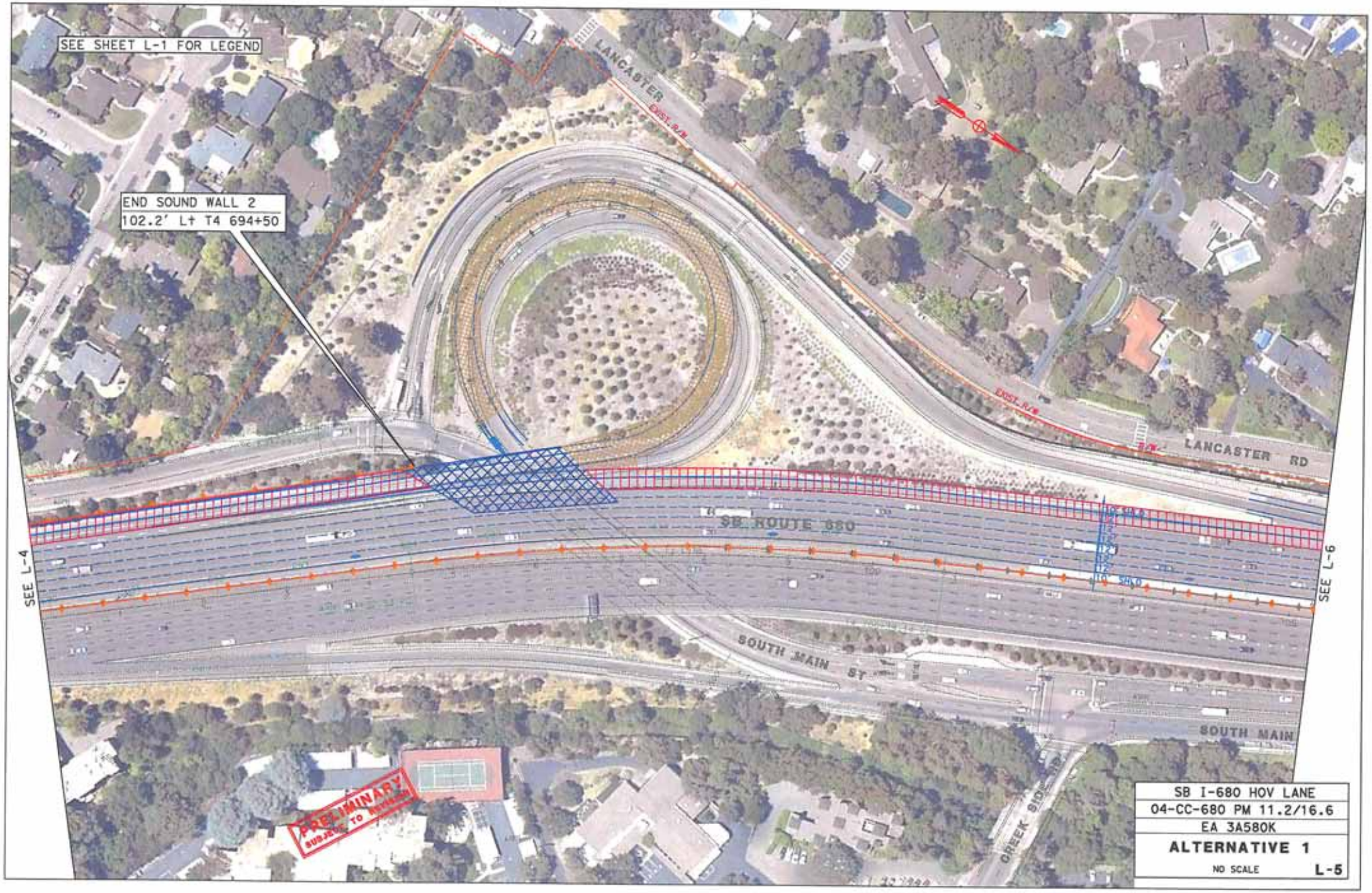
SB I-680 HOV LANE
04-CC-680 SB PM 11.2/16.6
EA 3A580K
KEY MAP
NO SCALE


LEGEND
Widen mainline roadway
Reconstruct median shoulder
Reconstruct On-Ramp
Widen bridge
Cold Plane to conform to existing
Replace median barrier
PRELIMINARY
SUBJECT TO REVISION
EXIST. R/W
END SOUND WALL 1
BEGIN RETAINING WALL 1
82.2' Lt A3 636+00
SB ROUTE 680
BEGIN CONSTRUCTION (SB ONLY)
CONFORM TO EXISTING
BEGIN SOUND WALL 1
82' Lt A3 629+00
SEE L-2
DELINEATIONS SHOWN ARE FOR STUDY ONLY
SB I-680 HOV LANE
04-CC-680 PM 11.2/16.6
EA 3A580K
ALTERNATIVE 1
NO SCALE
L-1

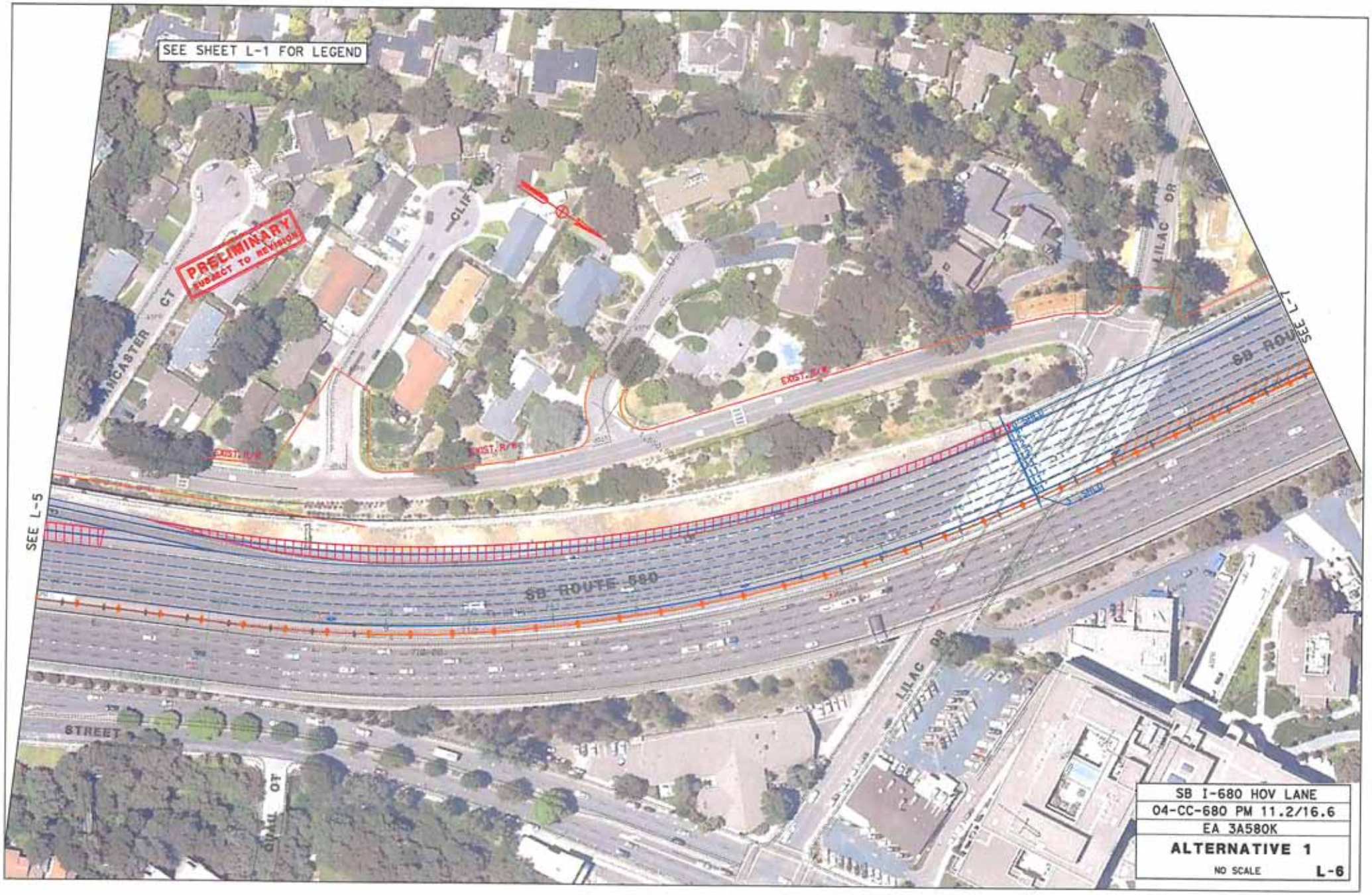

SEE SHEET L-1 FOR LEGEND
END RETAINING WALL 2
140' L+ A3 656+00
END RETAINING WALL 1
BEGIN RETAINING WALL 2
89.7' L+ A3 637+50
SB ROUTE 680
SEE L-1
SEE L-3
PRELIMINARY
SUBJECT TO REVISION
SB I-680 HOV LANE
04-CC-680 PM 11.2/16.6
EA 3A580K
ALTERNATIVE 1
NO SCALE
L-2

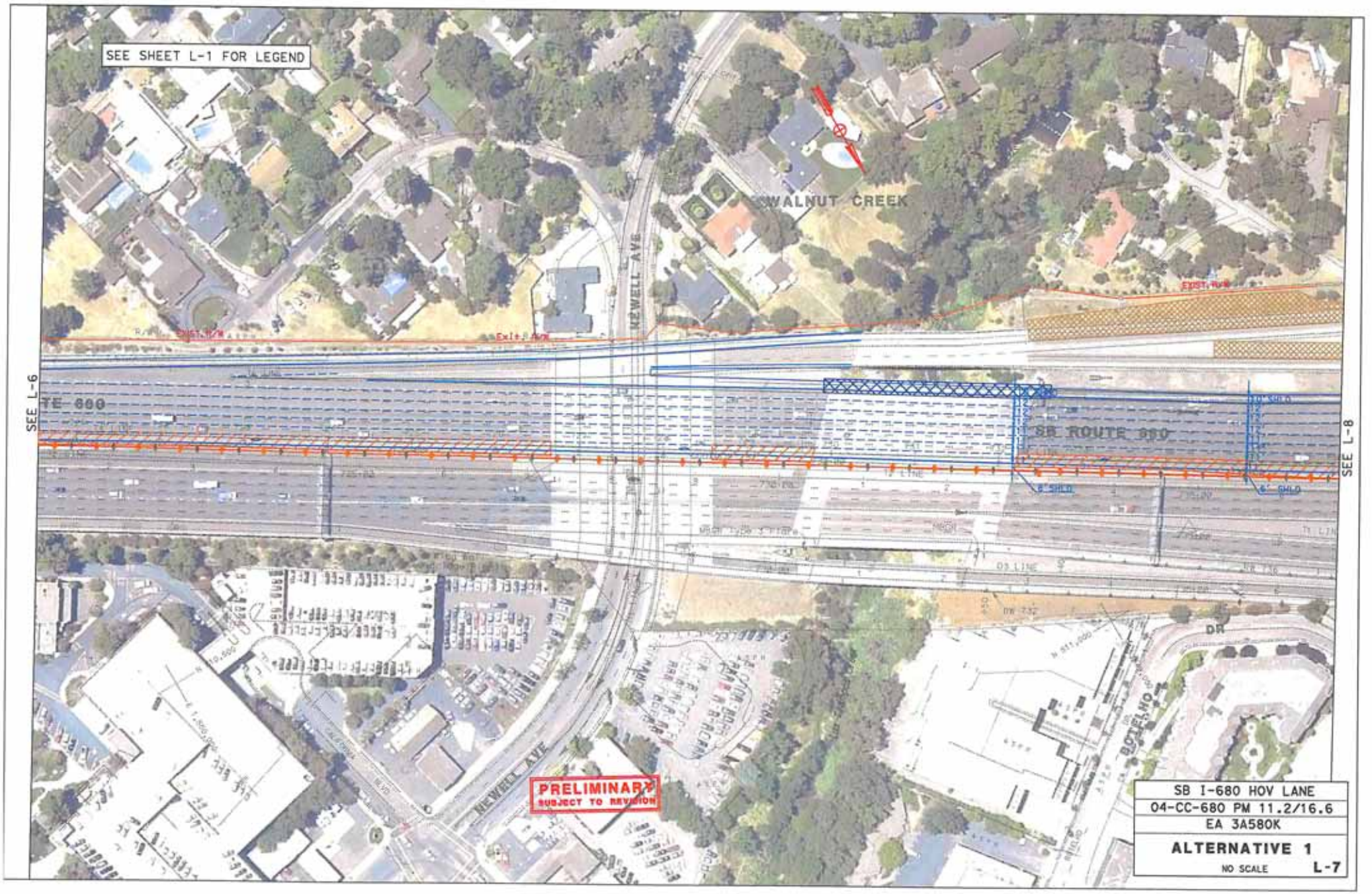

SEE SHEET L-1 FOR LEGEND
PRELIMINARY
SUBJECT TO REVISION
BEGIN SOUND WALL 2
83.2' Lt A4 672+70
EXIST. R/W
RUDGEAR ROAD
SB ROUTE 680
SEE L-2
SEE L-3
SEE L-4
Conform
Calaveras River
RUDGEAR ROAD
SB I-680 HOV LANE
04-CC-680 PM 11.2/16.6
EA 3A580K
ALTERNATIVE 1
NO SCALE
L-3

SB I-680 HOV LANE
04-CC-680 PM 11.2/16.6
EA 3A580K
ALTERNATIVE 1
NO SCALE
L-4

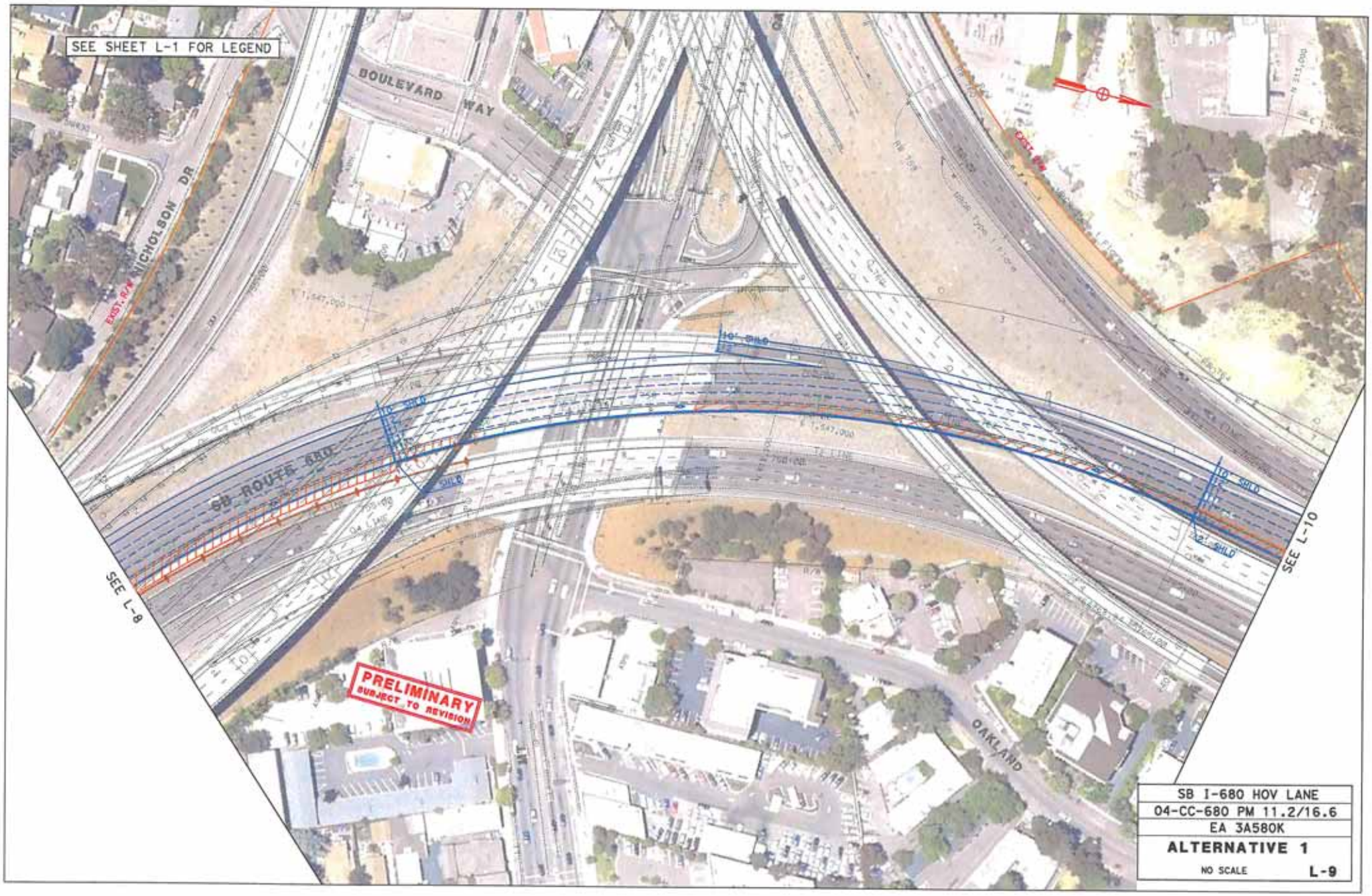


SB I-680 HOV LANE
04-CC-680 PM 11.2/16.6
EA 3A580K
ALTERNATIVE 1
NO SCALE L-5

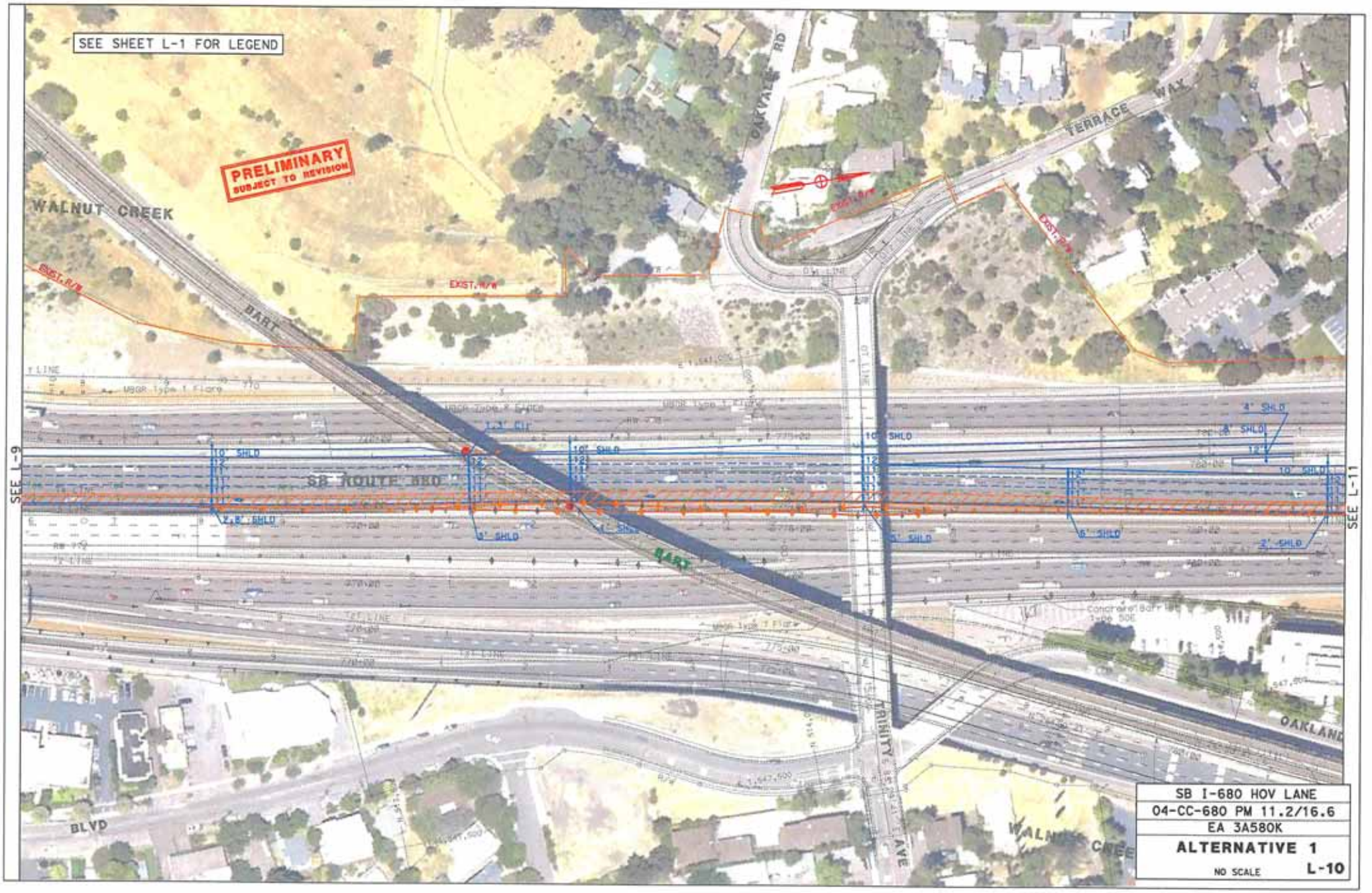

SEE SHEET L-1 FOR LEGEND
PRELIMINARY
SUBJECT TO REVISION
LANCASTER CT
CLIFTON CT
LILAC DR
SEE L-1
SEE L-5
SB ROUTE 580
EXIST. R/W
STREET
DALE CT
SB I-680 HOV LANE
04-CC-680 PM 11.2/16.6
EA 3A580K
ALTERNATIVE 1
NO SCALE
L-6


SEE SHEET L-1 FOR LEGEND
SEE L-6
SEE L-8
WALNUT CREEK
NEWELL AVE
SR ROUTE 680
PRELIMINARY
SUBJECT TO REVISION
SB I-680 HOV LANE
04-CC-680 PM 11.2/16.6
EA 3A580K
ALTERNATIVE 1
NO SCALE
L-7


SEE SHEET L-1 FOR LEGEND
SEE L-7
SEE L-9
OLYMPIC BLVD
WALNUT CREEK
EXIST. R/W
SB I-680
PRELIMINARY
SUBJECT TO REVISION
SB I-680 HOV LANE
04-CC-680 PM 11.2/16.6
EA 3A580K
ALTERNATIVE 1
NO SCALE
L-8



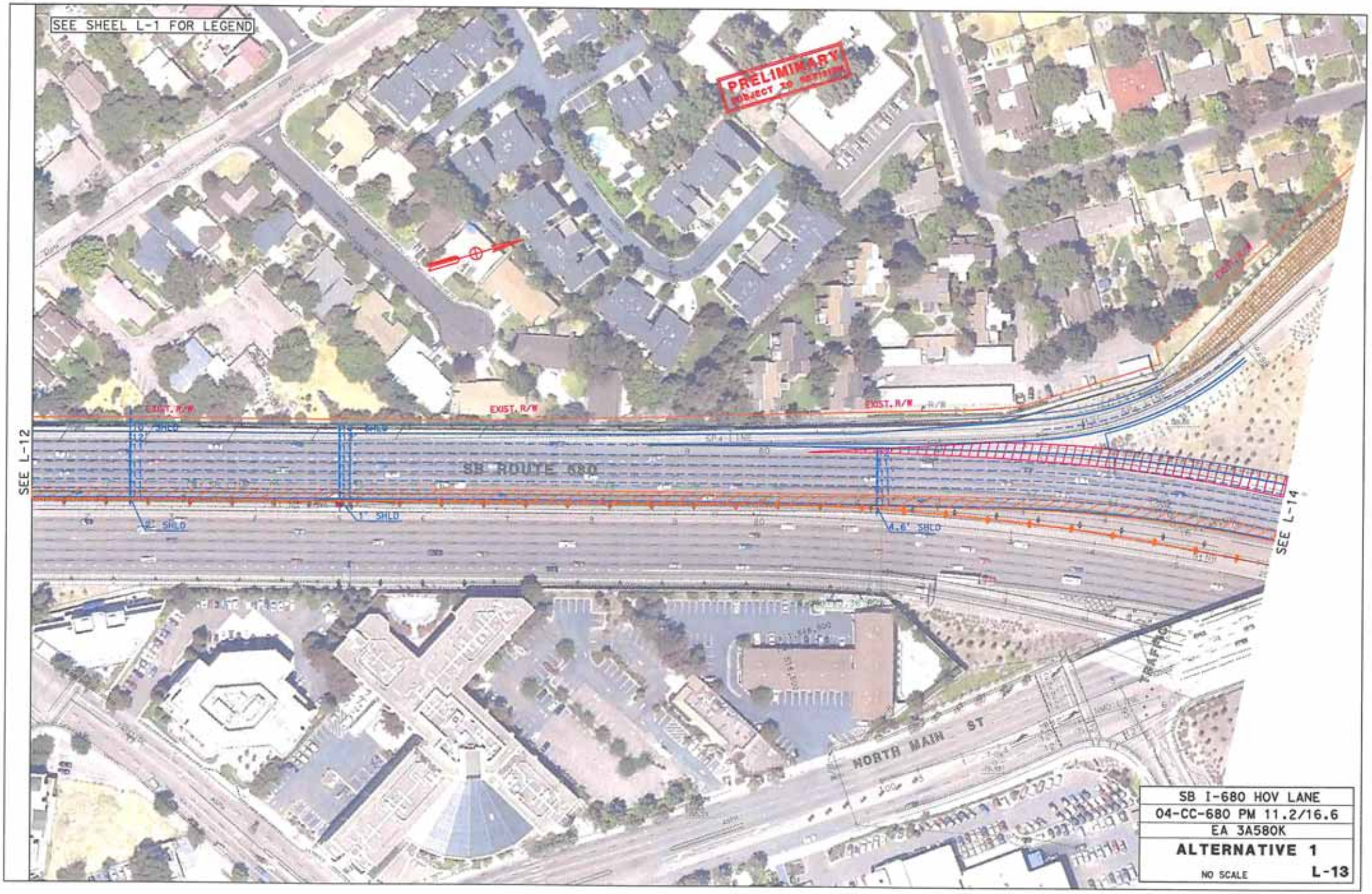
SB I-680 HOV LANE
04-CC-680 PM 11.2/16.6
EA 3A580K
ALTERNATIVE 1
NO SCALE L-9

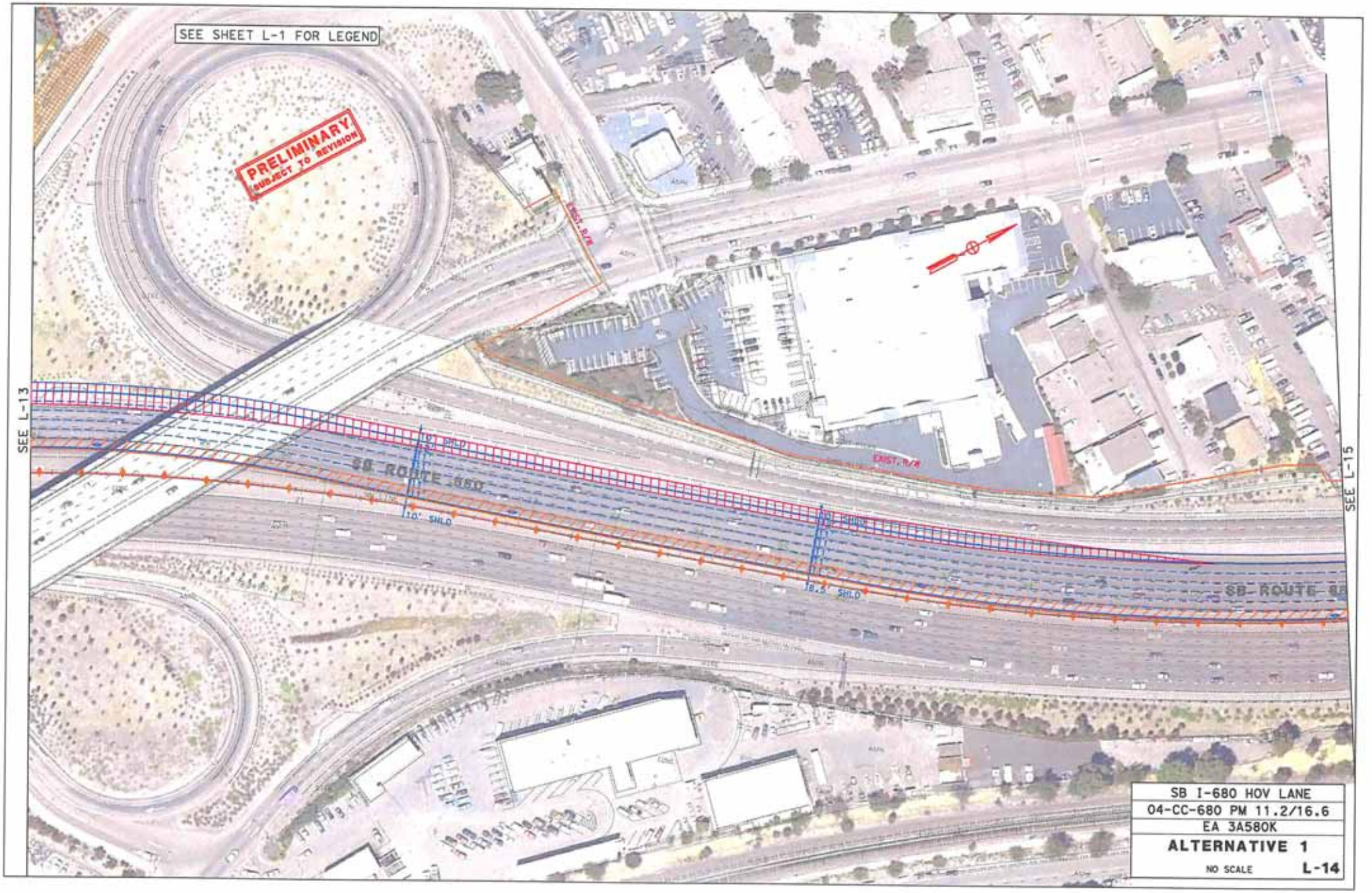


SB I-680 HOV LANE
04-CC-680 PM 11.2/16.6
EA 3A580K
ALTERNATIVE 1
NO SCALE
L-10


SEE SHEET L-1 FOR LEGEND
SEE L-10
SEE L-12
EXIST. R/W
SB ROUTE 680
YGNACIO VALLEY RD
BLVD
WALNUT CREE
PRELIMINARY
SUBJECT TO REVISION
SB I-680 HOV LANE
04-CC-680 PM 11.2/16.6
EA 3A580K
ALTERNATIVE 1
NO SCALE
L-11


SEE SHEET L-1 FOR LEGEND
SEE L-11
SEE L-13
PARKSIDE DRIVE
EXIST. R/W
EXIST. R/W
EXIST. R/W
SB ROUTE 880
SHLD
PRELIMINARY
SUBJECT TO REVISION
RIVIERA AVE
SB I-680 HOV LANE
04-CC-680 PM 11.2/16.6
EA 3A580K
ALTERNATIVE 1
NO SCALE
L-12


SEE SHEEL L-1 FOR LEGEND
PRELIMINARY
SUBJECT TO REVISION
EXIST. R/W
EXIST. R/W
EXIST. R/W
SB ROUTE 680
SEE L-12
SEE L-14
2' SHLD
1' SHLD
4.6' SHLD
NORTH MAIN ST
SB I-680 HOV LANE
04-CC-680 PM 11.2/16.6
EA 3A580K
ALTERNATIVE 1
NO SCALE
L-13


SEE SHEET L-1 FOR LEGEND
PRELIMINARY
SUBJECT TO REVISION
SEE L-13
SEE L-15
SB ROUTE 680
SB ROUTE 680
10' SHLD
12' SHLD
EXIST. R/W
EXIST. R/W
SB ROUTE 680
SB I-680 HOV LANE
04-CC-680 PM 11.2/16.6
EA 3A580K
ALTERNATIVE 1
NO SCALE
L-14


SEE SHEET L-1 FOR LEGEND
PRELIMINARY
subject to revision
CONFORM TO EXISTING
NM 26+90
EXIST. R/W
EXIST. R/W
SB ROUTE 880
2' SHLD
2' SHLD
2' SHLD
SEE L-14
SEE L-16
SB I-680 HOV LANE
04-CC-680 PM 11.2/16.6
EA 3A580K
ALTERNATIVE 1
NO SCALE
L-15

SB I-680 HOV LANE
04-CC-680 PM 11.2/16.6
EA 3A580K
ALTERNATIVE 1
NO SCALE
L-16

SB I-680 HOV LANE
04-CC-680 PM 11.2/16.6
EA 3A580K
ALTERNATIVE 1
NO SCALE L-17

Appendix B
Cost Estimate Details

PRELIMINARY PROJECT COST ESTIMATE SUMMARY

DIST-CO-RTE: 04-CC- SB 680
PM: 11.2/16.6
EA 3A580K

Project Description: HOV Lane Gap Closure (Alternative 1 - Widening and Restriping)

Limits: On Southbound Interstate 680 from Livorna Road (PM 11.2) to Geary Road (PM16.6)

Proposed Improvement (Scope): Widening and resptriping existing roadway to add an HOV lane, reconstructing retaining and sou walls, widening and replacing bridges, modifying existing fiber optical cable and traffic operation systems, installing on-ramp metering systems, and upgrading median barrier to standard.

TOTAL ROADWAY ITEMS	*$ 40,543,000*
TOTAL STRUCTURE ITEMS	*$ 4,704,000*
SUBTOTAL CONSTRUCTION COSTS	*$ 45,247,000*
TOTAL RIGHT OF WAY ITEMS	*$ 636,000*
TOTAL CURRENT PROJECT CAPITAL OUTLAY COSTS	**$ 45,883,000**
TOTAL MID-YEAR CONSTRUCTION PROJECT CAPITAL OUTLAY COSTS	**$ 59,134,000**

DRAFT
SUBJECT TO REVISION

Approved By: Signature: _____ Date: _____
Project Manager: Yadollah Fathollahi

PRELIMINARY PROJECT COST ESTIMATE SUMMARY

DIST-CO-RTE: 04-CC- SB 680
PM: 11.2/16.6
EA 3A580K

I. ROADWAY ITEMS

Section 1 - Earthwork

	Quantity	Unit	Unit Price	Item Cost	Section Cost
Roadway Excavation	6950	CY	$ 35	$ 243,250	
Imported Borrow	50	CY	$ 100	$ 5,000	
Contaminated Soil Disposal	13539	CY	$ 250	$ 3,384,750	
Clearing & Grubbing	1	LS	$ 55,000	$ 55,000	
Develop Water Supply	1	LS	$ 50,000	$ 50,000	
				***Total Earthwork**	***$ 3,738,000***

Section 2 - Pavement Structural Section

	Quantity	Unit	Unit Price	Item Cost	Section Cost
Asphalt Concrete (Open Graded)	3667	TON	$ 95	$ 348,365	
Hot Mixed Asphalt, (Type A)	22905	TON	$ 90	$ 2,061,450	
Asphalt Treated Permeable Base	3385	CY	$ 90	$ 304,650	
Lean Concrete Base	8173	CY	$ 150	$ 1,225,950	
Aggregate Base (Class 3)	4067	CY	$ 50	$ 203,350	
Aggregate Sub-Base, AS (Class 4)	25621	CY	$ 25	$ 640,525	
Remove Base and Surfacing	35900	CY	$ 21	$ 753,900	
Remove AC Dike	2100	LF	$ 5	$ 10,500	
Place AC Dike	3000	LF	$ 5	$ 15,000	
Cold Plane AC Pavement	8000	SQ FT	$ 4	$ 32,000	
Shoulder Backing	10	CY	$ 60	$ 600	
			Subtotal Pavement Structural Items		***$ 5,596,290***

Section 3 - Drainage

	Quantity	Unit	Unit Price	Item Cost	Section Cost
Modify Drainage System	1	LS	$ 2,500,000	$ 2,500,000	
				Total Drainage (Lump Sum)	***$ 2,500,000***

PRELIMINARY PROJECT COST ESTIMATE SUMMARY

DIST-CO-RTE: 04-CC- SB 680
PM: 11.2/16.6
EA 3A580K

Section 4- Specialty Items

	Quantity	Unit	Unit Price	Item Cost	Section Cost
Reconstruct MBGR	1	LS	$ 120,000	$ 120,000	
Remove Concrete Barrier (Type 50)	21120	LF	$ 10	$ 211,200	
Concrete Barrier (Type 60)	21120	LF	$ 60	$ 1,267,200	
Remove Crash Cushion, Sand Filled	3	EA	$ 1,100	$ 3,300	
Crash Cushion, Sand Filled	3	EA	$ 4,000	$ 12,000	
Permanent Treatment BMP	1	LS	$ 960,000	$ 960,000	
Design Pollution Prevention BMP	1	LS	$ 300,000	$ 300,000	
Construction Site BMP	1	LS	$ 500,000	$ 500,000	
Special Landscaping	1	LS	$ 1,300,000	$ 1,300,000	
Environmental Mitigation	1	LS	$ 4,900,000	$ 4,900,000	
Resident Engineer's Office	1	LS	$ 320,000	$ 320,000	
Power and Telephone Service	1	LS	$ 50,000	$ 50,000	
				Total Specialty Items	***$ 9,943,700***

PRELIMINARY PROJECT COST ESTIMATE SUMMARY

DIST-CO-RTE: 04-CC- SB 680
PM: 11.2/16.6
EA 3A580K

Section 5 - Traffic Items

	Quantity	Unit	Unit Price	Item Cost	Section Cost
Transportation Management Plan (TMP)	1	LS	$ 1,165,000	$ 1,165,000	
Relocate Sign Structures	2	EA	$ 7,500	$ 15,000	
Roadside Sign and Phone Box	14	EA	$ 400	$ 5,600	
Modify Fiber Optical Conduit System	1	LS	$ 235,000	$ 235,000	
Modify Traffic Operations System	1	LS	$ 200,000	$ 200,000	
Install Ramp Metering	8	EA	$ 100,000	$ 800,000	
Highway Lighting	1	LS	$ 170,000	$ 170,000	
Thermoplastic Stripe	1	LS	$ 55,000	$ 55,000	
Remove Thermoplastic Stripe	1	LS	$ 45,000	$ 45,000	
Thermoplastic Pavement Marking	1	LS	$ 10,000	$ 10,000	
Remove Thermoplastic Pavement Marking	1	LS	$ 5,000	$ 5,000	
Pavement Marker	1	LS	$ 45,000	$ 45,000	
Remove Pavement Marker	1	LS	$ 12,000	$ 12,000	
Temporary Pavement Delineation	1	LS	$ 80,000	$ 80,000	
Temporary Railing (Type K)	53200	LF	$ 15	$ 798,000	
				Total Traffic Items	***$ 3,640,600***
				TOTAL SECTIONS 1-5	**$ 25,418,590**
				Use	**$ 25,419,000**

Section 6 - Minor Items

			Unit Cost	Section Cost
Subtotal Section 1-5	$ 25,419,000	x 10% =	$ 2,541,900	
			Total Minor Items	***$ 2,541,900***

Section 7 - Roadway Mobilization

Subtotal Section (1-5)	$ 25,419,000			
Minor Items (6)	$ 2,541,900			
Sum (1-6)	$ 27,960,900	x 10% =	$ 2,796,090	
			Total Roadway Mobilization	***$ 2,796,090***

Section 8 - Roadway Additions

Supplemental Work

Subtotal Sections (1-5)	$ 25,419,000		
Minor Items (6)	$ 2,541,900		
Sum (1-6)	$ 27,960,900	x 10% =	$ 2,796,090

Contingencies

Subtotal Sections 1-5	$ 25,419,000		
Minor Items (6)	$ 2,541,900		
Sum	$ 27,960,900	x 25% =	$ 6,990,225
		Total Roadway Additions	***$ 9,786,000***

TOTAL ROADWAY ITEMS (Total of Sections 1-8) $ 40,543,000

Estimate Prepared by: Project Engineer — Signature: _____ Li Lin — Date: _____

PRELIMINARY PROJECT COST ESTIMATE SUMMARY

DIST-CO-RTE: 04-CC- SB 680
PM: 11.2/16.6
EA 3A580K

II. STRUCTURES ITEMS

		Cost			
	Unit	Structure 1	Structure 2	Structure 3	Structure 4
Structure Type					
Wall Removal	SQ FT	9,800	30,520		
Masonry Soundwall	SQ FT	9,800	30,520		
Soil nail retaining wall without piling	SQ FT	7,365			
Type 1 retaining wall without piling	LF	750			
Total Cost Per Structure		*$1,226,800*	*$1,159,760*		
Subtotal Wall Structures Items		$2,387,000			
10% mobilization		$238,700			
25% contingency		$596,750			
Cost of Widening bridges*		$920,000	$561,000		

*Including 10% mobilization and 25% contingency

TOTAL STRUCTURES ITEMS **$ 4,704,000**

PRELIMINARY PROJECT COST ESTIMATE SUMMARY

DIST-CO-RTE: 04-CC- SB 680
PM: 11.2/16.6
EA 3A580K

III. RIGHT OF WAY ITEMS

	Current Values (Future Use)	Escalation Rates	Escalated Values
Utility Relocation (State Share)	$ 636,000	0%	$ 636,000
Title and Escrow Fees	$ -	0%	$ -
Acquisition, including Excess Lands	$ -	5%	$ -
Grantor's Appraisal Cost			
TOTAL RIGHT OF WAY		**$ 636,000**	

DRAFT PRELIMINARY PROJECT CONSTRUCTION COST ESTIMATE SUMMARY

District-County-Route	04-CC-680
KP(PM)	
EA	
Program Code	

PROJECT DESCRIPTION:

Limits	In Walnut Creek, Contra Costa County
	From 0.3 mile south of Ygnacio Valley Road Undercrossing
	To 0.1 mile north of N. Main Street Overcrossing
Proposed Improvement (Scope)	It is proposed to construct HOV direct connect ramps to and from the north that connect to a new roadway that will cross under NB I-680, which then connects to the perimeter road at the Walnut Creek BART station
Alternative	n/a

SUMMARY OF PROJECT CONSTRUCTION COST ESTIMATE

TOTAL ROADWAY ITEMS	$ 92,246,000
TOTAL STRUCTURE ITEMS	$ 12,009,000
SUBTOTAL CONSTRUCTION COSTS	$ 104,255,000
TOTAL RIGHT OF WAY ITEMS (NOT INCLUDED IN THIS ESTIMATE)	$ N/A
TOTAL PROJECT CAPITAL OUTLAY COSTS	$ 104,255,000
SAY	**$ 105,000,000**

DRAFT PRELIMINARY PROJECT CONSTRUCTION COST ESTIMATE SUMMARY

District-County-Route 04-CC-680
KP(PM)
EA

I. ROADWAY ITEMS

Section 1 Earthwork	Quantity	Unit	Unit Price	Item Cost	Section Cost
Imported Borrow	58,000	CY	$ 40.00	$ 2,320,000	
Clearing and Grubbing	1	LS	$ 200,000.00	$ 200,000	
				Subtotal Earthwork	$ 2,520,000
Section 2 Pavement Structural Section					
Portland Cement Concrete Pavement	5,400	CY	$ 270.00	$ 1,458,000	
Lean Concrete Base	300	CY	$ 180.00	$ 54,000	
Aggregate Sub Base	4,100	CY	$ 25.00	$ 102,500	
Remove Concrete Pavement	52,800	SF	$ 10.00	$ 528,000	
				Subtotal Pavement Structural Section	$ 2,142,500
Section 3 Drainage and BMPs					
Storm Drains	1	LS	$ 2,400,000.00	$ 2,400,000	
				Subtotal Drainage and BMPs	$ 2,400,000

DRAFT PRELIMINARY PROJECT CONSTRUCTION COST ESTIMATE SUMMARY

District-County-Route 04-CC-680
KP(PM)
EA

Section 4 Specialty Items

Caltrans Type 1 Walls	92,000	SF	$ 200.00	$ 18,400,000	
U Wall System	1	LS	$ 15,600,000.00	$ 15,600,000	
Sound Walls	62,600	SF	$ 60.00	$ 3,756,000	
Barriers and Guardrails	10,000	FT	$ 76.00	$ 760,000	
Remove Sound Walls	62,600	SF	$ 10.00	$ 626,000	
Permanent Treatment BMP	1	LS	$ 1,300,000.00	$ 1,300,000	
Design Pollution Prevention BMP	1	LS	$ 900,000.00	900,000	
Construction Site BMP	1	LS	$ 1,700,000.00	$ 1,700,000	
				Subtotal Specialty Items	$ 43,042,000

Section 5 Traffic Items

Lighting	1	LS	$ 100,000.00	$ 100,000	
Traffic Delineation Items	1	LS	$ 50,000.00	$ 50,000	
Traffic Signals	1	EA	$ 250,000.00	$ 250,000	
Overhead Sign Structure Relocation	3	EA	$ 10,000.00	$ 30,000	
Overhead Sign Structure Replacement	1	LS	$ 100,000.00	$ 100,000	
New Overhead Sign Structures	1	LS	$ 100,000.00	$ 100,000	
Roadside Signs	1	LS	$ 20,000.00	$ 20,000	
Traffic Control Systems	1,000	DAYS	$ 5,000.00	$ 5,000,000	
Transportation Management Plan	1	LS	$ 1,750,000.00	$ 1,750,000	
Temporary K-Rail	22,000	FT	$ 15.00	$ 330,000	
				Subtotal Traffic Items	$ 7,730,000

TOTAL SECTIONS 1 thru 5 $ 57,834,500

DRAFT PRELIMINARY PROJECT CONSTRUCTION COST ESTIMATE SUMMARY

District-County-Route 04-CC-680
KP(PM)
EA

				Item Cost	Section Cost
Section 6 Minor Items					
Subtotal Sections 1thru 5	$ 57,834,500	x 10%	= $	5,783,450	$ 5,783,450
			TOTAL MINOR ITEMS		
Section 7 Roadway Mobilization					
Subtotal Sections 1 thru 6	$ 63,617,950	x 10%	= $	6,361,795	$ 6,361,795
			TOTAL ROADWAY MOBILIZATION		
Section 8 Roadway Additions					
Supplemental Work:	$ 63,617,950	x 10%	= $	6,361,795	$ 6,361,795
Contingencies:	$ 63,617,950	x 25%	= $	15,904,488	$ 15,904,488
			TOTAL ROADWAY ADDITIONS		$ 22,266,283
			TOTAL ROADWAY ITEMS		**$ 92,246,028**
			(Subtotal Sections 1 thru 8)		
			USE		**$ 92,246,000**

Estimate Prepared By	D. Elkins	Phone No.	510-587-7567	Date	4/3/2009
Estimate Checked By	V. Chio	Phone No.	510-587-7588	Date	4/3/2009

DRAFT PRELIMINARY PROJECT CONSTRUCTION COST ESTIMATE SUMMARY

District-County-Route 04-CC-680
KP(PM)
EA

II. STRUCTURE ITEMS

Bridge Name	Ygnacio Valley Rd UC - 1		Cost per ft^2		
Remove Existing Bridge - (FT^2)	1.00	$	LS	$	500,000
New Bridge - (FT^2)	5948	$	350.00	$	2,081,800
Total Cost for Structure				$	2,581,800
Bridge Name	Ygnacio Valley Rd UC - 2		Cost per ft^2		
New Bridge - (FT^2)	6503	$	350.00	$	2,276,022
Total Cost for Structure				$	2,276,022
Bridge Name	Ygnacio Valley Rd UC - 3		Cost per ft^2		
New Bridge - (FT^2)	2489	$	350.00	$	871,140
Total Cost for Structure				$	871,140
Bridge Name	BART Access Road UC		Cost per ft^2		
New Bridge - (FT^2)	5743	$	350.00	$	2,009,896
Total Cost for Structure				$	2,009,896
Bridge Name	Parkside UC		Cost per ft^2		
New Bridge - (FT^2)	2892	$	400.00	$	1,156,716
Total Cost for Structure				$	1,156,716

Contingencies (Includes 10% Mobilization & 25% Contingency): $ 8,895,574 x 35% = $ **3,113,451**

TOTAL STRUCTURES ITEMS $ 12,009,024

(Sum of Structures Items plus Railroad Items)

USE $ **12,009,000**

Estimate Prepared By D. Elkins Phone No. 510-587-7567 Date 4/3/2009

I-680 HOV Express Bus Study
Date: 04/08/2009
By: FXC, Reviewed by: KJF

DKS Associates
TRANSPORTATION SOLUTIONS

Conceptual Cost Estimate : Option 3 : Buskirk Roadway Improvements

#	Bid Item	Quantity	Unit	Unit Price	Cost
	Roadway Improvement				
1	City of Pleasant Hill Estimate	1	LS	$ 7,000,000.00	$ 7,000,000.00
	Transit Signal Priority Improvement				
2	Opticom Aux Cable	3	EA	$ 150.00	$ 450.00
3	Sensors and Phase Selector	1	EA	$ 1,759.00	$ 1,759.00
4	M-138 Opticom Cable	2000	LF	$ 0.41	$ 820.00
5	Opticom Detector	4	EA	$ 402.00	$ 1,608.00
6	GTT Tech Support	1	LS	$ 2,000.00	$ 2,000.00
7	Contractor Install Estimate	1	LS	$ 15,000.00	$ 15,000.00
8	EVP/TSP Discrimination Unit	9	EA	$ 250.00	$ 2,250.00
9	Emitter	6	EA	$ 995.00	$ 5,970.00
10	Programming and Configurating Controller for TSP	9	EA	$ 5,000.00	$ 45,000.00
				Subtotal	$ 7,074,860.00
	Contingency for TSP Improvement (35%)				$26,200.00
				Grand Total	**$ 7,101,060.00**

Transit Signal Priority Improvement Assumptions:
Length of Opticom cable for full intersection = 1000 LF
Length of Opticom cable for half intersection = 500 LF
Existing EVP system shall be adapted as the proposed EVP/TSP system
New EVP/TSP discriminator unit is required for each intersection

I-680 HOV Express Bus Study
Date: 03/18/2009
By: FXC, Reviewed by: AIP

DKS Associates
TRANSPORTATION SOLUTIONS

Conceptual Cost Estimate : Option 4 : Long Distance Bus Consolidation at Walnut Creek BART

#	Bid Item	Quantity	Unit	Unit Price	Cost
	Transit Signal Priority Improvement				
1	Opticom Aux Cable	3	EA	$ 150.00	$ 450.00
2	Sensors and Phase Selector	2	EA	$ 1,759.00	$ 3,518.00
3	M-138 Opticom Cable	1500	LF	$ 0.41	$ 615.00
4	Opticom Detector	3	EA	$ 402.00	$ 1,206.00
5	GTT Tech Support	1	LS	$ 2,000.00	$ 2,000.00
6	Contractor Install Estimate	1	LS	$ 15,000.00	$ 15,000.00
7	EVP/TSP Discrimination Unit	6	EA	$ 250.00	$ 1,500.00
8	Emitter	6	EA	$ 995.00	$ 5,970.00
9	Programming and Configurating Controller for TSP	6	EA	$ 5,000.00	$ 30,000.00
				Subtotal	$ 60,260.00
	Contingency (35%)				$21,100.00
				Grand Total	**$ 81,360.00**

Transit Signal Priority Improvement Assumptions:
Length of Opticom cable for full intersection = 1000 LF
Length of Opticom cable for half intersection = 500 LF
Existing EVP system shall be adapted as the proposed EVP/TSP system
New TVP/TSP discriminator unit is required for each intersection.

I-680 HOV Express Bus Study
Date: 03/18/2009
By: FXC, Reviewed by: AIP

DKS Associates
TRANSPORTATION SOLUTIONS

Conceptual Cost Estimate : Option 5 : General TSP/Queue Jump Lanes

#	Bid Item	Quantity	Unit	Unit Price	Cost
	Transit Signal Priority Improvement				
1	Opticom Aux Cable	2	EA	$ 150.00	$ 300.00
2	Sensors and Phase Selector	1	EA	$ 1,759.00	$ 1,759.00
3	M-138 Opticom Cable	1500	LF	$ 0.41	$ 615.00
4	Opticom Detector	3	EA	$ 402.00	$ 1,206.00
5	GTT Tech Support	1	LS	$ 2,000.00	$ 2,000.00
6	Contractor Install Estimate	1	LS	$ 15,000.00	$ 15,000.00
7	EVP/TSP Discrimination Unit	14	EA	$ 250.00	$ 3,500.00
8	Emitter	6	EA	$ 995.00	$ 5,970.00
9	Programming and Configurating Controller for TSP	14	EA	$ 5,000.00	$ 70,000.00
	Queue Jump Lane Improvement				
10	Striping	400	LF	$ 2.00	$ 800.00
11	Pavement Marking	756	SF	$ 3.00	$ 2,268.00
12	Signage	5	EA	$ 400.00	$ 2,000.00
13	Signal Pole for Bus Phase Only	5	EA	$ 7,000.00	$ 35,000.00
14	Modify Conductors and Conduits	3	EA	$ 10,000.00	$ 30,000.00
15	Modify Signal Phasing	3	EA	$ 2,000.00	$ 6,000.00
				Subtotal	$ 176,420.00
	Contingency (35%)				$61,750.00
				Grand Total	$ 238,170.00

Transit Signal Priority Improvement Assumptions:
Length of Opticom cable for full intersection = 1000 LF

Appendix C
Consistency in HOV Hours of Operation and Occupancy Requirements for I-680 and the Benicia-Martinez Bridge

DKS Associates
TRANSPORTATION SOLUTIONS

MEMORANDUM

TO:	I-680 HOV/Express Bus Study TAC
FROM:	William R. Loudon, DKS Associates
DATE:	March 26, 2009
SUBJECT:	Issue Paper: Consistency in HOV Hours of Operation and Occupancy Requirements for I-680 and the Benicia-Martinez Bridge

1. INTRODUCTION

Today, the Benicia-Martinez Bridge and I-680 in Contra Costa County each have high occupancy vehicle (HOV) lanes, but with different hours of operation and different vehicle occupancy requirements. The purpose of this paper is to identify the issues that might arise with establishing consistent hours of operation and vehicle occupancy requirements on the two facilities and to determine the potential effects on the volume of vehicular travel, vehicle occupancy, travel time on HOV facilities and bridge toll revenue in the corridor. The paper begins with a description of the existing characteristics of the facilities in corridor. This includes identification of the HOV lane facilities, the hours of operations and the vehicle-occupancy requirements. It also includes a description of the existing and expected future (2030) traffic volumes and patterns of congestion during the hours of operation. The paper then includes an analysis of the options for achieving consistency and the effects of each option and concludes with a summary of the potential effects of changing the HOV lane hours of operation or vehicle occupancy requirements.

2. EXISTING CONDITIONS

2.1. HOV Facilities, Hours of Operation and Vehicle-Occupancy Requirements

Along the Contra Costa County portion of the I-680 corridor, northbound and southbound HOV lanes are in place but do not form a continuous network. As shown in Figure 1, a set of northbound and southbound HOV lanes are provided south of SR 24 from Alcosta Boulevard to Livorna Road. A second set of HOV lanes are provided north of SR 24 northbound from the SR 242 interchange to Marina Vista Avenue and southbound from Marina Vista Avenue to North Main Street in Walnut Creek. Although there is currently no HOV lane northbound between North Main Street and SR 242, addition of a lane is planned and this is reflected in the 2030 analysis. At the Benicia-Martinez Bridge toll plaza, a northbound HOV toll bypass lane is provided north of Marina Vista Avenue, but this lane is not directly connected to the HOV lane south of the toll plaza. The toll plaza and HOV bypass lane are at the northbound entrance to the bridge on the south side of the river.

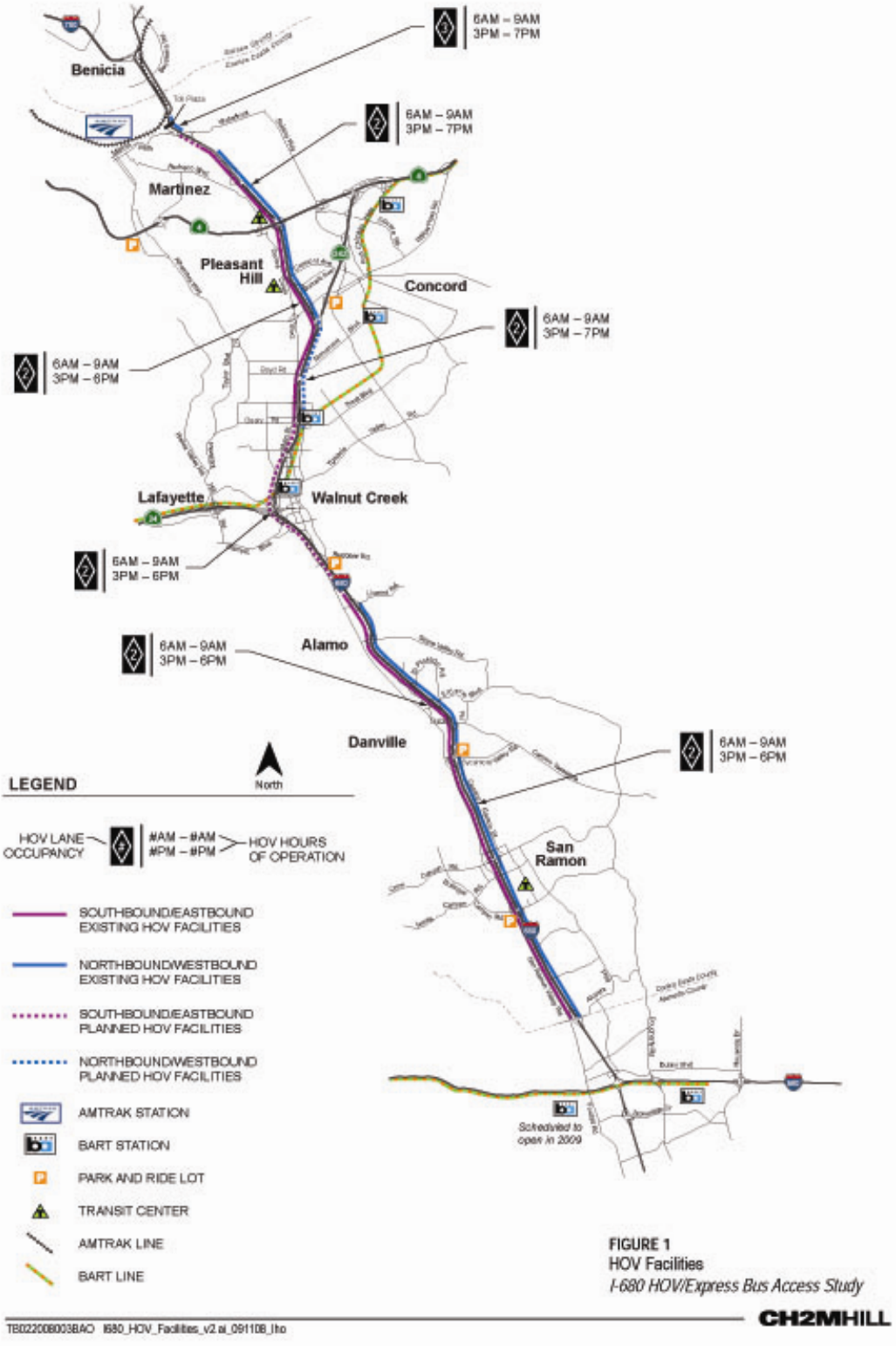


FIGURE 1
HOV Facilities
I-680 HOV/Express Bus Access Study

The hours of operation and vehicle occupancy requirement for the HOV toll bypass lane differ from those for the rest of the HOV facilities on I-680. As summarized in Table 1, the HOV toll bypass lane on the Benicia-Martinez Bridge operates longer hours in the northbound direction during the AM peak period than the rest of the freeway. During the PM peak period, the HOV hours are the same as the portion of the HOV lane on I-680 north of SR 24, but south of SR 24, the HOV hours of operation end earlier at 6:00 PM. The vehicle-occupancy requirements are also different between the two facilities, with the HOV toll bypass lane requiring 3 or more persons per vehicle and the HOV lanes on I-680 requiring 2 or more persons per vehicle.

Table 1 I-680 and Benicia-Martinez Bridge HOV Hours of Operation and Lane Vehicle-Occupancy Requirements

	I-680 South of SR 24	I-680 North of SR 24	Benicia - Martinez Bridge
I-680 Northbound			
HOV Lane Limits	Alcosta Boulevard to Livorna Road	North Main Street to Marina Vista	Marina Vista through Toll Plaza
HOV Lane Operation Hours	Weekdays 6:00 AM - 9:00 AM 3:00 PM - 6:00 PM	Weekdays 6:00 AM - 9:00 AM 3:00 PM - 7:00 PM	Weekdays 5:00 AM - 10:00 AM 3:00 PM - 7:00 PM
Occupancy Requirement	2+	2+	3+
I-680 Southbound			
HOV Lane Limits	Livorna Road to Alcosta Boulevard	Marina Vista to North Main Street	No HOV facility in this direction
HOV Lane Operation Hours	Weekdays 6:00 AM - 9:00 AM 3:00 PM - 6:00 PM	Weekdays 6:00 AM - 9:00 AM 3:00 PM - 6:00 PM	-
Occupancy Requirement	2+	2+	-

Source: 511.org, August 2008

While the Benicia-Martinez Bridge and I-680 differ in the hours of operation and vehicle-occupancy requirements for their HOV lanes, there is no difference in the hours of operation for the HOV lanes on the San Francisco-Oakland Bay Bridge, the Carquinez Bridge, and I-80 as indicated in Table 2. They have the same hours of operation and vehicle-occupancy requirements as the Benicia-Martinez Bridge. The HOV network on I-80 is also more connected, with only a small gap in coverage in both directions south of the Carquinez Bridge.

Table 2 I-80, San Francisco-Oakland Bay Bridge, and Carquinez Bridge HOV Hours of Operation

	Bay Bridge	I-80	Carquinez Bridge
I-80 Eastbound			
HOV Lane Limits	No HOV facility in this direction	Powell Street to SR 4	Toll Plaza
HOV Lane Operation Hours	-	Weekdays 5:00 AM - 10:00 AM 3:00 PM - 7:00 PM	Weekdays 5:00 AM - 10:00 AM 3:00 PM - 7:00 PM
Occupancy Requirement	-	3+	3+
I-80 Westbound			
HOV Lane Limits	Toll Plaza	Carquinez Bridge to Bay Bridge Toll Plaza	No HOV facility in this direction
HOV Lane Operation Hours	Weekdays 5:00 AM - 10:00 AM 3:00 PM - 7:00 PM	Weekdays 5:00 AM - 10:00 AM 3:00 PM - 7:00 PM	-
Occupancy Requirement	3+	3+	-

Source: 511.org, August 2008

While the Antioch, Benicia-Martinez, Carquinez and San Francisco-Oakland Bay Bridges have consistent hours of operation and occupancy requirements, there is not consistency among all of the state-owned Bay Area bridges that are operated by the Bay Area Toll Authority (BATA). The Richmond-San Rafael, Dumbarton and San Mateo-Hayward Bridges all have shorter hours in the PM peak (3:00 PM to 6:00PM) and the occupancy requirement for HOV on the Dumbarton and San Mateo-Hayward Bridges is only two or more. State law[1] stipulates that BATA may grant toll free passage or a reduced-rate schedule for vehicles occupied by three or more persons, including the driver, but there was special legislation enacted that allowed the lower occupancy requirement on the Dumbarton San Mateo-Hayward Bridges. Legislative changes are being considered that would allow BATA to set carpool occupancy requirements for all of the bridges under its control. The Golden Gate Bridge; which is owned and operated by the independent Golden Gate Bridge, Highway and Transportation District; has the shortest hours of HOV toll bypass operation (5:00 AM to 9:00 AM and 4:00 PM to 6:00 PM) and requires an occupancy of three or more.

The differences in the hours of operation and vehicle occupancy requirements for HOV toll bypass on the Bay Area bridges reflects a regional policy of tailoring the HOV facilities to local conditions and corridor needs. This policy is also reflected in the variation in the hours of operation and vehicle occupancy requirements for HOV lanes on Bay Area freeways.

[1] Streets & Highways Code Section 30889.3 (a)

2.2. Traffic Volume

Existing AM peak period traffic volumes from 5:00 AM to 10:00 AM and PM peak period traffic volumes from 3:00 PM to 7:00 PM at selected points along I-680 are shown in Table 3. In general, northbound traffic volumes are below the three- to five-lane capacity during the AM peak period assuming a general purpose lane capacity of 2,100 vehicles per hour per lane (everywhere except the six-lane section south of SR 242 in the northbound direction where a capacity of 2000 vplph is used because of weaving movements) and an HOV lane capacity of 1,600[2] vehicles per hour per lane. Table 4 summarizes the expected future (2030) traffic volumes for AM and PM peak period traffic volumes at the same selected points on I-680. The future year forecasts are based on the CCTA travel forecasting model and a FREQ simulation of corridor operations. The forecasts indicate that both the HOV lane and the general-purpose lane will be at or over the practical capacity northbound in the AM and PM peaks south of SR 4.

To determine the number of vehicles eligible for HOV access, vehicle-occupancy distribution counts were taken on I-680 between SR 242 and Marina Vista and at the Benicia-Martinez Bridge Toll Plaza. The results are provided in Table 5. The occupancy counts on I-680 were available for each hour between 5:00 and 10:00 AM and 3:00 PM to 7:00 PM while the counts at the toll plaza were available only for the period between 6:00 and 10:00 AM and for the single hour 8:00 to 9:00 AM and for the period between 3:00 PM and 6:00 PM and for a single hour 4:00 to 6:00 PM. These occupancy counts were used to estimate the distribution of vehicles by occupancy level for all points where traffic counts were taken. Different observation methods were used at the bridge toll plaza and along I-680, and the two methods produced significantly different estimates particularly of the percentage of vehicles that have three or more occupants. The estimates from the toll plaza are used in the analysis of potential changes in bridge traffic in the remainder of this paper and the estimates on I-680 are used for analysis related to the HOV lanes on I-680.

2.3. Transit Service

Transit service, which is eligible for HOV lane access, is currently provided across the Benicia-Martinez Bridge by Vallejo Transit, Benicia Transit and Solano Express. During the five-hour AM peak period there are a total of 13 buses that cross the Benicia-Martinez Bridge northbound. As of January 1, 2009, Vallejo Transit Route 78 runs 7 buses from Walnut Creek BART and Pleasant Hill BART to Benicia and Vallejo; Benicia Breeze Route 76 runs 2 buses from Benicia to Diablo Valley College and the Sun Valley Mall; and Solano Express Route 40 runs 4 buses northbound from Walnut Creek BART and Pleasant Hill BART to Benicia, Fairfield, and Vacaville.

[2] The capacity of an HOV is lower because the speed difference between HOV lanes and adjacent general-purpose lanes results in side friction that can result in a degradation of HOV speed and throughput. Speed differential with the HOV lane also has an impact, because HOV vehicles do not have multiple lanes within which to sort out traffic by speed.

Table 3 - I 680 Peak Period Traffic Volumes - Existing Conditions

Direction	Freeway Segment	Facility Type	Number of Lanes	Capacity	AM Peak Period										PM Peak Period							
					5:00 AM to 6:00 AM		6:00 AM to 7:00 AM		7:00 AM to 8:00 AM		8:00 AM to 9:00 AM		9:00 AM to 10:00 AM		3:00 PM to 4:00 PM		4:00 PM to 5:00 PM		5:00 PM to 6:00 PM		6:00 PM to 7:00 PM	
					Vol/ Lane	V/C Ratio	Vol/ Lane	V/C Ratio	Vol/ Lane	V/C Ratio	Vol/ Lane	V/C Ratio	Vol/ Lane	V/C Ratio	Vol/ Lane	V/C Ratio	Vol/ Lane	V/C Ratio	Vol/ Lane	V/C Ratio	Vol/ Lane	V/C Ratio
Northbound	North of SR 4	General Purpoase Lanes	3	2100	480	0.23	920	0.44	1,330	0.63	1,110	0.53	930	0.44	1,380	0.66	1,390	0.66	1,350	0.64	930	0.44
		HOV Lanes	1	1600	110	0.07	210	0.13	300	0.19	250	0.16	210	0.13	790	0.49	790	0.49	770	0.48	530	0.33
	North of SR 242	General Purpoase Lanes	3	2100	300	0.14	790	0.38	1,620	0.77	1,500	0.71	1,330	0.63	1,670	0.80	1,660	0.79	1,720	0.82	1,370	0.65
		HOV Lanes	1	1600	70	0.04	180	0.11	370	0.23	340	0.21	300	0.19	950	0.59	950	0.59	980	0.61	780	0.49
	South of SR 242	General Purpoase Lanes	6	2000	320	0.16	730	0.37	1,240	0.62	1,150	0.58	1,040	0.52	1,480	0.74	1,500	0.75	1,500	0.75	1,310	0.66
		HOV Lanes																				
Southbound	North of SR 4	General Purpoase Lanes	3	2100	520	0.25	1,290	0.61	1,350	0.64	1,260	0.60	830	0.40	1,200	0.57	1,240	0.59	1,250	0.60	930	0.44
		HOV Lanes	1	1600	210	0.13	530	0.33	550	0.34	520	0.33	340	0.21	310	0.19	320	0.20	330	0.21	240	0.15
	North of SR 242	General Purpoase Lanes	3	2100	540	0.26	1,410	0.67	1,510	0.72	1,450	0.69	1,120	0.53	1,290	0.61	1,290	0.61	1,310	0.62	1,000	0.48
		HOV Lanes	1	1600	220	0.14	580	0.36	620	0.39	590	0.37	460	0.29	340	0.21	340	0.21	340	0.21	260	0.16
	South of SR 242	General Purpoase Lanes	5	2100	1,090	0.52	1,710	0.81	1,570	0.75	1,440	0.69	1,290	0.61	1,390	0.66	1,430	0.68	1,430	0.68	1,070	0.51
		HOV Lanes	1	1600	740	0.46	1,170	0.73	1,070	0.67	980	0.61	880	0.55	600	0.38	620	0.39	620	0.39	470	0.29

Source: DKS Associates estimates based on a combination of traffic counts and vehicle occupancy counts taken in 2006, 2007 and 2008.

Table 4 - I 680 Peak Period Traffic Volumes - Future Conditions

Direction	Freeway Segment	Facility Type	Number of Lanes	Capacity	AM Peak Period										PM Peak Period							
					5:00 AM to 6:00 AM		6:00 AM to 7:00 AM		7:00 AM to 8:00 AM		8:00 AM to 9:00 AM		9:00 AM to 10:00 AM		3:00 PM to 4:00 PM		4:00 PM to 5:00 PM		5:00 PM to 6:00 PM		6:00 PM to 7:00 PM	
					Vol/ Lane	V/C Ratio	Vol/ Lane	V/C Ratio	Vol/ Lane	V/C Ratio	Vol/ Lane	V/C Ratio	Vol/ Lane	V/C Ratio	Vol/ Lane	V/C Ratio	Vol/ Lane	V/C Ratio	Vol/ Lane	V/C Ratio	Vol/ Lane	V/C Ratio
Northbound	North of SR 4	General Purpoase Lanes	3	2100	750	0.36	1,560	0.74	1,760	0.84	1,620	0.77	1,520	0.72	1,680	0.80	1,750	0.83	1,660	0.79	1,350	0.64
		HOV Lanes	1	1600	170	0.11	460	0.29	570	0.36	470	0.29	400	0.25	1,030	0.64	1,100	0.69	950	0.59	580	0.36
	North of SR 242	General Purpoase Lanes	3	2100	440	0.21	1,450	0.69	2,060	0.98	2,030	0.97	1,810	0.86	2,050	0.98	2,060	0.98	2,030	0.97	1,830	0.87
		HOV Lanes	1	1600	100	0.06	490	0.31	780	0.49	670	0.42	590	0.37	1,020	0.64	1,050	0.66	880	0.55	710	0.44
	South of SR 242	General Purpoase Lanes	6	2000	430	0.22	1,200	0.60	1,540	0.77	1,420	0.71	1,320	0.66	1,870	0.94	1,920	0.96	1,800	0.90	1,570	0.79
		HOV Lanes	1	1600	200	0.13	780	0.49	1,130	0.71	960	0.60	840	0.53	1,790	1.12	1,890	1.18	1,050	0.66	1,170	0.73
Southbound	North of SR 4	General Purpoase Lanes	3	2100	740	0.35	2,080	0.99	1,920	0.91	1,660	0.79	1,210	0.58	1,980	0.94	2,010	0.96	920	0.44	1,270	0.60
		HOV Lanes	1	1600	300	0.19	510	0.32	600	0.38	490	0.31	390	0.24	680	0.43	700	0.44	690	0.43	540	0.34
	North of SR 242	General Purpoase Lanes	3	2100	460	0.22	1,230	0.59	690	0.33	1,330	0.63	1,300	0.62	1,780	0.85	870	0.41	930	0.44	1,390	0.66
		HOV Lanes	1	1600	190	0.12	710	0.44	710	0.44	570	0.36	540	0.34	700	0.44	720	0.45	730	0.46	570	0.36
	South of SR 242	General Purpoase Lanes	5	2100	1,040	0.50	1,640	0.78	1,200	0.57	1,480	0.70	1,410	0.67	1,840	0.88	1,320	0.63	1,330	0.63	1,330	0.63
		HOV Lanes	1	1600	710	0.44	1,160	0.73	1,110	0.69	910	0.57	860	0.54	990	0.62	1,030	0.64	1,020	0.64	760	0.48

Source: DKS Associates estimates based on estimates of existing occupancy levels, CCTA model forecasts of 2030 traffic volumes and FREQ analysis of freeway flows.

Table 5 Vehicle Occupancy Distribution on I-680 and the Benicia-Martinez Bridge

Northbound AM Peak Period

Facility	Vehicle Occupancy	Time Period					
		5:00 - 6:00 AM	6:00 - 7:00 AM	7:00 - 8:00 AM	8:00 - 9:00 AM	9:00 - 10:00 AM	6:00 - 9:00 AM
I-680 between SR 242 and Marina Vista	1 Passenger	94.3%	87.5%	90.2%	90.1%	89.1%	89.1%
	2 Passengers	5.1%	10.9%	9.0%	8.8%	9.5%	9.5%
	3+ Passengers	0.6%	1.5%	0.8%	1.2%	1.5%	1.5%
Benicia-Martinez Bridge Toll Plaza	1 Passenger	-	-	-	86.1%	-	85.1%
	2 Passengers	-	-	-	10.0%	-	9.8%
	3+ Passengers	-	-	-	3.9%	-	5.1%

Southbound AM Peak Period

Facility	Vehicle Occupancy	Time Period					
		5:00 - 6:00 AM	6:00 - 7:00 AM	7:00 - 8:00 AM	8:00 - 9:00 AM	9:00 - 10:00 AM	6:00 - 9:00 AM
I-680 between SR 242 and Marina Vista	1 Passenger	92.8%	78.6%	75.8%	78.8%	83.1%	77.8%
	2 Passengers	5.9%	19.8%	22.4%	19.7%	15.4%	20.6%
	3+ Passengers	1.3%	1.6%	1.9%	1.5%	1.5%	1.7%

Northbound PM Peak Period

Facility	Vehicle Occupancy	Time Period				
		3:00 - 4:00 PM	4:00 - 5:00 PM	5:00 - 6:00 PM	6:00 - 7:00 PM	3:00 - 6:00 PM
I-680 between SR 242 and Marina Vista	1 Passenger	80.8%	81.5%	82.1%	80.7%	81.3%
	2 Passengers	17.4%	16.9%	16.4%	17.4%	17.0%
	3+ Passengers	1.8%	1.6%	1.4%	1.9%	1.7%
Benicia-Martinez Bridge Toll Plaza	1 Passenger	-	82.5%	-		83.1%
	2 Passengers	-	10.5%	-		9.9%
	3+ Passengers	-	7.0%	-		6.9%

Southbound PM Peak Period

Facility	Vehicle Occupancy	Time Period				
		3:00 - 4:00 PM	4:00 - 5:00 PM	5:00 - 6:00 PM	6:00 - 7:00 PM	3:00 - 7:00 PM
I-680 between SR 242 and Marina Vista	1 Passenger	80.3%	82.0%	80.6%	79.2%	80.6%
	2 Passengers	17.5%	16.5%	17.5%	17.8%	17.3%
	3+ Passengers	2.2%	1.5%	1.9%	3.1%	2.1%

Source: DKS Associates Observations 2008 and Caltrans District 4 Annual HOV Lanes Report, 2007. The two sources produced significantly different estimates for the percentage of vehicles that have three or more vehicles.

3. EVALUATION OF OPTIONS TO ACHIEVE CONSISTENCY IN HOURS OF OPERATION FOR HOV FACILITIES

3.1. Alternative Hours of Operation Considered

Consistency in the HOV lane hours of operation on I-680 and the Benicia-Martinez Bridge could be achieved in one of two ways:

1. The hours of operation on I-680 could be extended to 5:00 AM to 10:00 AM to match the hours on the Benicia-Martinez Bridge
2. The hours for the Benicia-Martinez Bridge could be reduced in the AM peak period to 6:00 AM to 9:00 AM to match those on I-680

Both options are considered below. During the PM peak period, the HOV lane hours of operation already match north of the SR 24 interchange.

The effects of the changes in HOV lane hours of operation are analyzed from three perspectives:

- Change in the total number of vehicle trips on I-680 during the AM peak period;
- Change in the number of HOV eligible vehicles during the AM peak period;
- Change in AM peak period travel time for HOV lane eligible vehicles, including transit; and
- Change in toll revenue at the Benicia-Martinez Bridge.

The results of the analysis are summarized in Table 6. The changes in Table 6 are for the entire five-hour AM peak period from 5:00 AM to 10:00 AM. The change in vehicle trips is the total for I-680 during that period. The change in HOV-eligible vehicles is the change in the number of vehicles eligible to use the HOV lane on I-680 under the occupancy restrictions of the option being tested. The change in travel time for HOV is the average change for a trip using the I-680 HOV lane. The change in bridge tolls per weekday is the net change for the entire peak period at the 2009 rate of $4 per vehicle.

3.2. Extending HOV Lane Hours of Operation on I-680

North of SR 24, the I-680 AM peak period HOV lane hours of operation are currently 6:00 AM – 9:00 AM. To match the hours of the Benicia-Martinez Bridge toll plaza, the hours would be extended to 5:00 AM – 10:00 AM in this scenario.

Change in AM peak period travel time

By extending the AM peak period HOV lane hours of operation on I-680 northbound, HOV lane eligible vehicles would have exclusive access to the HOV lane for two extra hours. Traffic volumes, however, are relatively low during the hours of 5:00 AM – 6:00 AM and 9:00 AM – 10:00 AM suggesting that the freeway is at a free-flow state and no travel-time savings for HOVs would be realized by extending the HOV lane hours of operation.

Table 6 - Expected Peak Period Changes from Alternative Options to Achieve Consistency in HOV Operation Hours

Alternative		AM Peak Period – 5:00 AM to 10:00 AM			
		Changes in Vehicle Trips	Change in HOV-Eligible Vehicles on I-680	Change in Travel Times for HOV	Changes in Bridge Tolls per Weekday
Increase HOV Lane Operation Hours on I-680 to 5:00-10:00 AM	Existing Conditions	0	0	0	0
	2030	-60	50	-2.2 Min NB 9-10 AM	$ -260
Reduce HOV Lane Operation Hours on Benicia-Martinez Bridge to 6:00-9:00 AM	Existing Conditions	50	-10	Possible Change at Toll Booth for Non-FasTrak Vehicles	$ 700
	2030	100	-20	Possible Change at Toll Booth for Non-FasTrak Vehicles	$ 890

FREQ simulations of I-680 for the existing condition and for 2030 were used to estimate travel-time differences between an HOV lane and the general-purpose lanes on the freeway. For the 2030 forecast no significant difference would be expected in the hour 5:00 AM – 6:00 AM, but the expected level of service would be better in an HOV lane during part of the hour 9:00 AM – 10:00 AM. The FREQ analysis indicated that the operation of the HOV lane on I-680 between 9:00AM and 10:00AM would result in an average time savings for HOVs of roughly 2.2 minutes in the northbound direction.

Change in the number of HOV eligible vehicles during the AM peak period

An incremental application of the CCTA mode choice model was used to assess the difference that the 2030 HOV lane travel time advantage in the hour 9:00 AM – 10:00 AM would have on traffic volumes by occupancy level. The assessment indicated that the travel time advantage is likely to shift roughly 105 SOV drivers to HOV – 82 to HOV2 and 23 to HOV3+. The total reduction in vehicular traffic on the freeway would be about 60 vehicles in the one-hour period. This is not like to change the overall level of service in the general-purpose lanes or the HOV lane appreciably.

Change in toll revenue at the Benicia-Martinez Bridge

Because there is not likely to be any change in the number of HOV eligible vehicles using the I-680 HOV lane under existing traffic conditions, there is not likely to be any change in toll revenue on Benicia-Martinez Bridge. If the shift in vehicle occupancy for

2030 in the hour 9:00 AM – 10:00 AM also occurs at the bridge, the loss in toll revenue would be roughly $260 per weekday.

3.3. Reducing HOV Lane Hours of Operation on the Benicia-Martinez Bridge

To match I-680 northbound, the AM peak period HOV lane hours of operation on the Benicia-Martinez Bridge are assumed to be reduced to 6:00 AM – 9:00 AM from the current hours of 5:00 AM – 10:00 AM for this scenario.

Change in AM peak period travel time

Reducing the HOV lane hours of operation on the Benicia-Martinez Bridge would have little effect on HOV or SOV travel time under existing and 2030 conditions because traffic volumes are relatively low on the bridge compared to capacity. Non-FasTrak HOVs, however, would need to stop at the toll booth when they previously could by-pass the toll plaza at highway speeds. This would add to their travel time as well as the travel time of non-FasTrak SOVs who are also stopping at the toll booth.

Change in the number of HOV eligible vehicles during the AM peak period

During the hours of 5:00 AM – 6:00 AM and 9:00 AM – 10:00 AM, there are approximately 3,818 vehicles that cross the Benicia-Martinez Bridge northbound, as shown in Table 4. An estimated 250 vehicles are HOV lane eligible (3+ occupancy) that would no longer be considered HOV-eligible on the bridge and would have to either pay a toll to cross the bridge or travel between 6:00 AM and 9:00 AM to avoid the toll. The HOVs may also disband into SOVs or choose not to travel at all.

One likely scenario is that most HOVs traveling within 15 minutes of the new HOV lane hours of operation would leave later or earlier to avoid paying the toll. It is also likely that some HOVs may shift routes entirely, such as to the Carquinez Bridge, to avoid paying the toll. Furthermore, some of the HOVs may disband altogether, resulting in new SOVs. An incremental mode choice assessment of the effect of the change in the hours of operation of the toll bypass on the bridge indicated that there would be an increase in the number of vehicles in the hour 5:00 AM – 6:00 AM of about 8 and in the hour 9:00 AM – 10:00 AM of about 42 as a result of the shift for HOV3+ to HOV2 and SOV. These vehicles would no longer be considered HOV-eligible on the bridge and would have to pay the toll each day. Using forecast volumes for 2030, the increase in total vehicles on the bridge in the hour 5:00 AM – 6:00 AM would be 20 and in the hour 9:00 AM – 10:00 AM would be 80. The change would result in a decrease in the number of HOV-eligible vehicles on I-680 of about 10 under existing conditions and about 20 in 2030.

Change in toll revenue at the Benicia-Martinez Bridge

Based on the assessment of the how the change in HOV hours on the Benicia-Martinez Bridge would affect the number of HOV eligible vehicles on the bridge, revenue from tolls could be increased by about $700 per day under existing conditions and about $890 per weekday in 2030.

4. EVALUATION OF OPTIONS TO ACHIEVE CONSISTENCY IN VEHICLE-OCCUPANCY REQUIREMENTS FOR HOV FACILITIES

4.1. Alternatives Occupancy Requirements Considered

Consistency in the HOV lane vehicle occupancy requirements on I-680 and the Benicia-Martinez Bridge could be achieved in one of two ways:

3. The occupancy requirement on I-680 could be increased to 3+ to match the requirement on the Benicia-Martinez Bridge
4. The occupancy requirement on the Benicia-Martinez Bridge I-680 could be reduced to 2+ to match the requirement on I-680

Both options are considered below.

The effects of the changes in HOV lane vehicle-occupancy requirements are analyzed from three perspectives:

- Change in the total number of vehicle trips on I-680 during the AM and PM peak periods;
- Change in the number of HOV-eligible vehicles on I-680 during the AM and PM peak periods;
- Change in AM and PM peak period travel times for HOV- eligible vehicles, including transit; and
- Change in toll revenue at the Benicia-Martinez Bridge.

The results of the analysis are summarized in Table 7. The changes in Table 7 are for the entire five-hour AM peak period from 5:00 AM to 10:00 AM and the entire PM peak period from 3:00 PM to 7:00 PM. The change in vehicle trips is the total for I-680 during each period. The change in HOV-eligible vehicles is the change in the number of vehicles eligible to use the HOV lane on I-680 under the occupancy restrictions of the option being tested. The change in travel time for HOV is the average change for a trip using the I-680 HOV lane. The change in bridge tolls per weekday is the net change for the entire peak period at the 2009 rate of $4 per vehicle.

4.2. Increasing Vehicle-occupancy Requirement for the HOV Lane on I-680

The vehicle-occupancy requirement on the I-680 segment north of SR 24 is 2+. To match the vehicle-occupancy on the Benicia-Martinez Bridge toll plaza, the vehicle-occupancy on I-680 could be increased to 3+. Even though the occupancy requirement on the Benicia-Martinez Bridge applies only in the northbound direction, the change in occupancy requirement on I-680 was assumed to be for both directions to ensure consistency on the facility.

Table 7 – Expected Peak Period Changes from Alternative Options to Achieve Consistency in HOV Occupancy Requirements

Alternative		AM Peak Period – 5:00 AM to 10:00 AM				PM Peak Period – 3:00 PM to 7:00 PM			
		Changes in Vehicle Trips	Change in HOV-Eligible Vehicles on I-680	Change in Travel Times for HOV	Changes in Bridge Tolls per weekday	Changes in Vehicle Trips	Change in HOV-Eligible Vehicles on I-680	Change in Travel Times for HOV (minutes)	Changes in Bridge Tolls per weekday
Raise Occupancy Requirements of I-680 HOV Lane to 3+	Existing Conditions	30	-2,680	0	$ 60	30	-4,940	0	$ 60
	2030	1,060	-3,930	0	$1,940	850	-6,380	-1.6 min. (3-5 PM: NB)	$ 1,210
Reduce Occupancy Requirement for Benicia-Martinez Bridge HOV Lane to 2+	Existing Conditions	-330	370	0	$-12,670	-510	640	0	$-12,370
	2030	-600	720	0	$-18,520	-830	980	-3.5 min. (3-5 PM: NB)	$-19,100

Change in the number of HOV-eligible vehicles during the peak period

Increasing the vehicle-occupancy requirement on I-680 northbound, would affect all of the vehicles with two passengers. As indicated in Table 5, this represents about 9.5% of the peak period I-680. Only the HOVs with three or more would be allowed to use the HOV lanes, and that represents only about 1.5% of total traffic today. Shifting the vehicles with two occupants to the general-purpose lanes would not have a significant effect on travel times in the HOV lane under existing conditions because the lanes are operating free flow, but the shift would increase the travel times in the general purpose lanes southbound in the AM peak and northbound in the PM peak. This would produce some additional incentive for formation of carpools with three or more occupants.

An incremental application of the CCTA mode choice model was used to assess the effect of the travel time difference on mode shift and vehicle occupancy. Under existing conditions, the difference in travel times between the HOV and the general purpose lane would not be enough to produce a significant shift to HOV3+. Instead, the change in occupancy requirement is likely to lead to carpools with two occupants breaking up into single-occupant trips. The net increase in total vehicle trips would be roughly 30 in both the AM and PM peak periods under existing conditions. Under existing conditions, the net decrease in HOV lane traffic would be about 2,680 during the three-hour AM peak hours and about 4,940 in the four-hour PM peak period. This represents over 85% of the HOV lane traffic.

In 2030 there would be a more significant travel-time advantage between the HOV lane and the general purpose lane and more shift to carpools of three or more occupants. As many as 350 new carpool trips with three or more occupants would result. Still the shift from two-occupant carpool trips to single-occupant trips would be significant and the result would be an increase in vehicle trips of 1,060 in the AM peak period and 850 in the PM peak period. The decrease in HOV lane traffic would be about 3,930 in the AM peak period and 6,380 in the PM peak period, still a reduction of over 85% of the HOV-eligible traffic.

Change in peak hour travel time for HOV lane eligible vehicles, including transit

The HOV lane V/C ratio would be reduced significantly if the vehicle-occupancy requirement is changed from 2+ to 3+ on I-680. This would have very little impact on the speed in the HOV lane today because the existing V/C ratio is 0.5 or less in the two I-680 segments. HOV users would continue to travel under free-flow conditions in the HOV lane as they now do. Under future (2030) conditions, the reduction in HOV-eligible vehicles is likely to have an effect on HOV travel time because the HOV lane is expected to be near capacity in the northbound direction from SR 24 to SR 242 between 3:00 PM and 5 PM. A change to the 3+ requirement would produce free-flow conditions in the HOV lane. The estimated average change in travel time for HOV-eligible vehicles would be about 1.6 minutes.

Under existing conditions, the general purpose lane V/C ratio would increase by 10% to 13%. This would have some effect in the segment between SR 242 and SR 4, but little effect in the segment between SR 4 and the bridge. Average operating speed in the

general purpose lanes between SR 242 and SR 4 would drop from 65 mph to 60 mph when the V/C ratio increases from 0.73 to 0.86. The segment between SR 4 and the bridge would have the same average operating speed of 65 mph when the V/C increases from 0.6 to 0.7. Increasing the vehicle-occupancy requirement from 2+ to 3+ would increase the travel time on the I-680 segment from SR 242 to SR 4 because travel speed would be reduced by approximately 5 mph, but would not affect travel time on I-680 segment from SR 4 to Benicia Martinez Bridge.

Under the future (2030) conditions, the general purpose lanes would already be congested in the northbound direction in the AM and PM peak periods. The shifting of two-person carpools to the general purpose lanes would have a significant impact on travel times in those lanes but would create a more significant travel-time advantage for HOV3+. The incremental mode choice analysis indicated that there could be an increase in HOV3+ of 330 trips on a daily basis, but without the travel time advantage for HOV2 many would revert to SOV. This is likely to result in a net increase in vehicles of about 1060 vehicles in the AM peak period and in about 850 vehicles in the PM peak.

Change in toll revenue at the Benicia-Martinez Bridge

The change in the vehicle-occupancy requirement on I-680 is likely to produce a small increase of about $120 per weekday under existing conditions and about $3150 in 2030. This is because the shift from HOV2 to SOV is expected to be much greater than the shift to HOV3+.

4.3. Reducing the Vehicle-occupancy Requirement for the Benicia-Martinez Bridge HOV Lane

To match the vehicle-occupancy on I-680 northbound, the vehicle-occupancy requirement on the Benicia-Martinez Bridge could be reduced to 2+.

Change in the number of HOV-eligible vehicles during the peak period

Some increase in HOV-eligible vehicles would be expected as a result of the change because vehicles with two people would then be allowed to use the bridge for free. This would provide an additional economic incentive for commuters driving alone to carpool with another person. The change in vehicle-occupancy requirement could also result in some reduction in the number of 3+ HOVs if there is no economic incentive to have a 3+ HOV arrangement instead of a two-person carpool arrangement. An incremental mode choice analysis of the effect of the change indicated that there would be an increase in HOV-eligible vehicles on I-680 in the northbound direction of about 1,010 on a daily basis under existing conditions and about 1700 in 2030. This represents an increase in the number of HOV-eligible vehicles of about 20% during the highest peak hours. The change would lead to a reduction in vehicle trips of about 840 under existing conditions and 1430 in 2030. If the vehicle-occupancy requirement on the Benicia Bridge was changed and the requirement on the Carquinez Bridge was not, there may also be some diversion of two-person HOVs from I-80 to I-680 for certain types of trips that can be served by either interstate highway.

Change in peak hour travel time for HOV lane eligible vehicles, including transit

A small change in the peak hour travel time might result under existing conditions because of an increase in the number of HOV-eligible vehicles on I-680 but it is very unlikely because the HOV lanes in both segments operate at free-flow speeds and the existing V/C ratio in the HOV lane are 0.5 or less. The number of HOV-eligible vehicles would have to increase by at least 50% before any change in travel speeds would be seen.

In 2030 the effect on the HOV lane travel time could be more significant because the northbound lane is expected to be at capacity between SR 24 and SR 242 between 3:00 PM and 5:00 PM. The increase in HOV-eligible vehicles would increase the average travel time for HOV lane users in the northbound direction between 3:00 PM and 5:00 PM by about 3.5 minutes.

Change in toll revenue at the Benicia-Martinez Bridge

At the current toll rate of $4 per vehicle, reducing the vehicle-occupancy requirement from 3+ to 2+ would result in a loss in revenue of about $12,670 per weekday in the AM peak and $12, 370 in the PM peak. Under the future 2030 conditions, the net loss in tolls would be about $18,520 per weekday in the AM peak and $19,100 in the PM peak.

5. CONCLUSIONS

This analysis of options for achieving consistency in the hours of operation and the vehicle-occupancy requirement of HOV facilities on I-680 and the Benicia-Martinez Bridge represents a first step in assessing the potential benefits and impacts and identifying the issues that might arise. A more comprehensive analysis would be necessary before any final decision could be made about changing the hours of operation or the occupancy requirements for HOV on either facility.

The analysis conducted for this issue paper does indicate that the response to a change of the hours of operation on either facility would not be particularly great. Increasing the HOV lane hours on I-680 would have virtually no impact at present but would have a modest benefit in 2030. It would reduce the total number of vehicle trips and increase the number of HOV-eligible vehicles, but it would decrease bridge toll revenue slightly. Reducing the HOV lane hours on the Benicia-Martinez Bridge would lead to an increase in vehicle trips, a reduction in HOV eligible vehicles, but an increase in bridge tolls under both existing and 2030 conditions.

The analysis conducted for this issue paper does indicate that the response to a change of the occupancy requirement on either facility would be significant. Increasing the HOV occupancy requirement on I-680 would reduce the number of HOV-eligible vehicles on I-680 by over 85% under both existing and 2030 conditions. This would results in some improvement in HOV lane travel times and some shift to HOV3+, but the more significant impact would be to shift HOV2 trips to SOV. This would increase the total number of vehicle trips and increase travel times in the general-purpose lanes. The shift would produce a small increase in toll revenue on the Benicia-Martinez Bridge of $120 per weekday under existing conditions and about $3150 per weekday in 2030. Reducing the HOV occupancy requirement on the Benicia-Martinez Bridge would also have a significant impact. It would increase the number of HOV-eligible vehicles on I-680 by about 20% and lead to a reduction in vehicle trips of about 840 per weekday under

existing conditions and 1430 under 2030 conditions. The major impact would be a loss in toll revenue of about $25,000 per weekday under existing conditions and about $37,600 per weekday under 2030 conditions. The current annual revenue on the Benicia-Martinez Bridge is roughly $74 million or about $200,000 per day.

Appendix D
I-680 Southbound HOV Lane Extension

Issue Paper
I-680 Southbound HOV Lane Extension

October 8, 2008

1. Introduction

CH2M HILL is submitting this deliverable as part of Task 7 of the I-680 HOV Express Bus Access Study. The question to be addressed in this issue paper is whether it is geometrically feasible to extend the existing I-680 southbound High Occupancy Vehicle (HOV) lane to the north and across the original Benicia-Martinez Bridge to I-780. Included in this paper is a discussion of the geometric configuration of the I-680 southbound near Benicia-Martinez Bridge, geometric feasibility issues involved in an HOV lane extension to the north, and conclusions regarding geometric feasibility. It is important to note that this issue paper is focused on geometric issues, and does not address traffic operations, impact on HOV and transit operations, HOV facility planning or policy considerations, environmental impacts or funding availability.

This geometric feasibility study serves as an initial step towards the long-term vision of continuous HOV lanes on I-680 that extend to the north to I-80. The study area of this project consists of the portion of I-680 southbound located between the I-780 interchange and south of the Marina Vista Avenue/ Waterfront Road interchange; which is the beginning of the existing southbound HOV lane. The study area is illustrated in **Figure 1**.

FIGURE 1
Project Study Area
I-680 Southbound HOV Lane Extentsion

2. Roadway Configuration

The corridor's main transportation feature is Interstate 680 (I-680) which runs north-south through the study area and is the major freeway connection between Solano County to the north and Alameda and Santa Clara Counties to the south. In August 2007, the California Department of Transportation (Caltrans) opened the New Benicia-Martinez Bridge, which carries the northbound traffic on I-680. As part of the overall New Benicia-Martinez Bridge Project, improvements to the I-680 / I-780 interchange and the southbound I-680 are under construction and are scheduled for completion in 2009. The proposed configuration at project completion is herein referred to as the Baseline Condition. Below are the major differences between the lane configuration before 2007 and Baseline Condition as they relate to the study:

- The original span of the Benicia-Martinez Bridge, which originally carried both northbound and southbound traffic, will carry four southbound general purpose lanes and a barrier-separated bicycle path.
- I-680/I-780 interchange will be reconstructed with improved geometrics. The former northbound-to-westbound and eastbound-to-northbound connectors and their associated structures will be demolished. The mainline southbound I-680 through the interchange has been realigned with an increased radius of curvature.
- The southbound HOV lane on I-680 will be extended northward by approximately 3,300 feet. The starting point of HOV lane will be located in between the Marina Vista Avenue/ Waterfront Road on- and off-ramps. Currently the starting point of southbound HOV lane is located approximately 2,800 feet south of the Marina Vista Avenue/ Waterfront Road on-ramp.

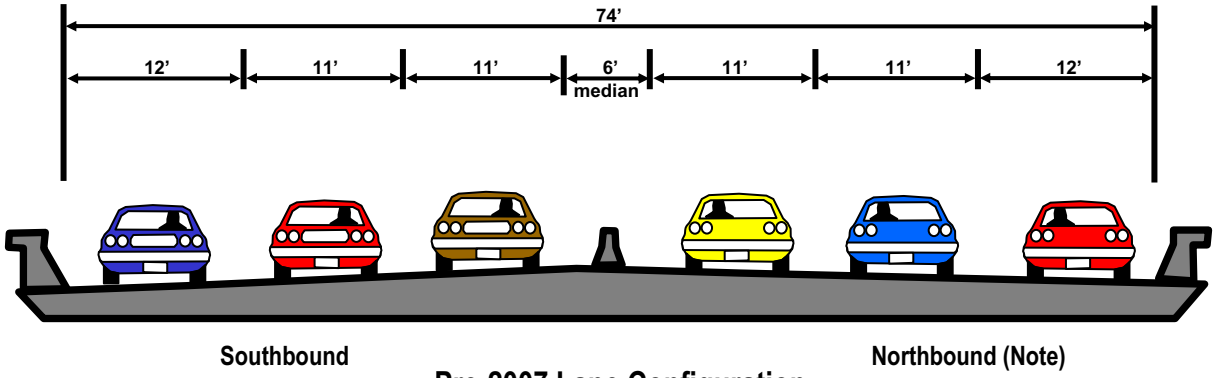
CH2M HILL has conferred with Caltrans regarding the structural condition of the original span of the Benicia-Martinez Bridge. We understand that the original span of the bridge will receive various structural upgrades as part of the overall bridge project to ensure its ability to carry both vehicular and non-vehicular (bicycle and pedestrian) traffic.

The lane configuration of I-680 southbound is presented in **Table 1**. The cross sections of I-680 on the original Benicia-Martinez Bridge under pre-construction and Baseline Conditions are illustrated in **Figure 2**.

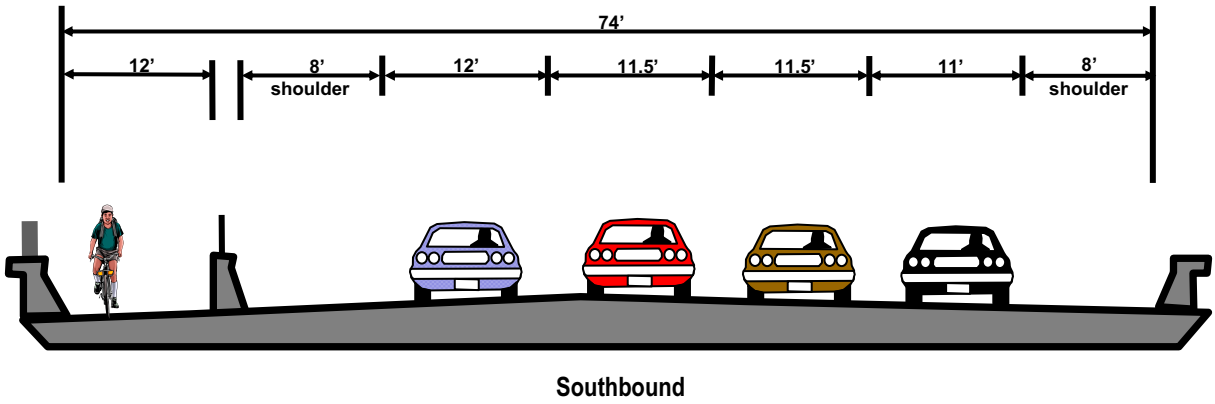
TABLE 1
I-680 Southbound Lane Configuration – Existing and Baseline Conditions

Freeway Segment	Number of Lanes Between Interchanges		
	Mainline	Auxiliary	HOV
Before 2007			
Bayshore Road on-ramp to I-780 on-ramp	2	1	0
I-780 on-ramp to Marina Vista Avenue off-ramp	3	0	0
Marina Vista Avenue on-ramp and Pacheco Boulevard off-ramp	3	0	1 – partial*
Baseline Condition (2009)			
Bayshore Road on-ramp to I-780 on-ramp	2	1	0
I-780 on-ramp to Marina Vista Avenue off-ramp	4	0	0
Marina Vista Avenue on-ramp and Pacheco Boulevard off-ramp	3	0	1

* The HOV lane begins 2,800 feet south of the Marina Vista Avenue on-ramp



Pre-2007 Lane Configuration



Post-2009 Lane Configuration
(Baseline Condition)

Source: Caltrans, July 2007
Note: The Northbound lanes were shifted to the new Benicia-Martinez Bridge in August 2007

FIGURE 2

I-680 Southbound Cross Section along Benicia-Martinez Bridge

3. Assessment of Geometric Feasibility

A geometric assessment was conducted based on the Baseline Condition as depicted on the as-advertised drawings prepared by Caltrans for the New Benicia-Martinez Bridge project, available aerial photos for the area, and field observations. The focus of the evaluation was primarily on the available cross-sectional width along southbound I-680 and the horizontal geometry of the reconfigured I-680/I-780 interchange as depicted on the as-advertised drawings.

Since I-680 southbound has three distinctly different cross-sections within the study area, the discussion below is divided into three segments: 1) south of the Benicia-Martinez Bridge; 2) on the Benicia-Martinez Bridge and 3) north of the Benicia-Martinez Bridge. See **Figure 3** for the limits of each of the three segments. Within each segment, one potentially feasible alternative is described.

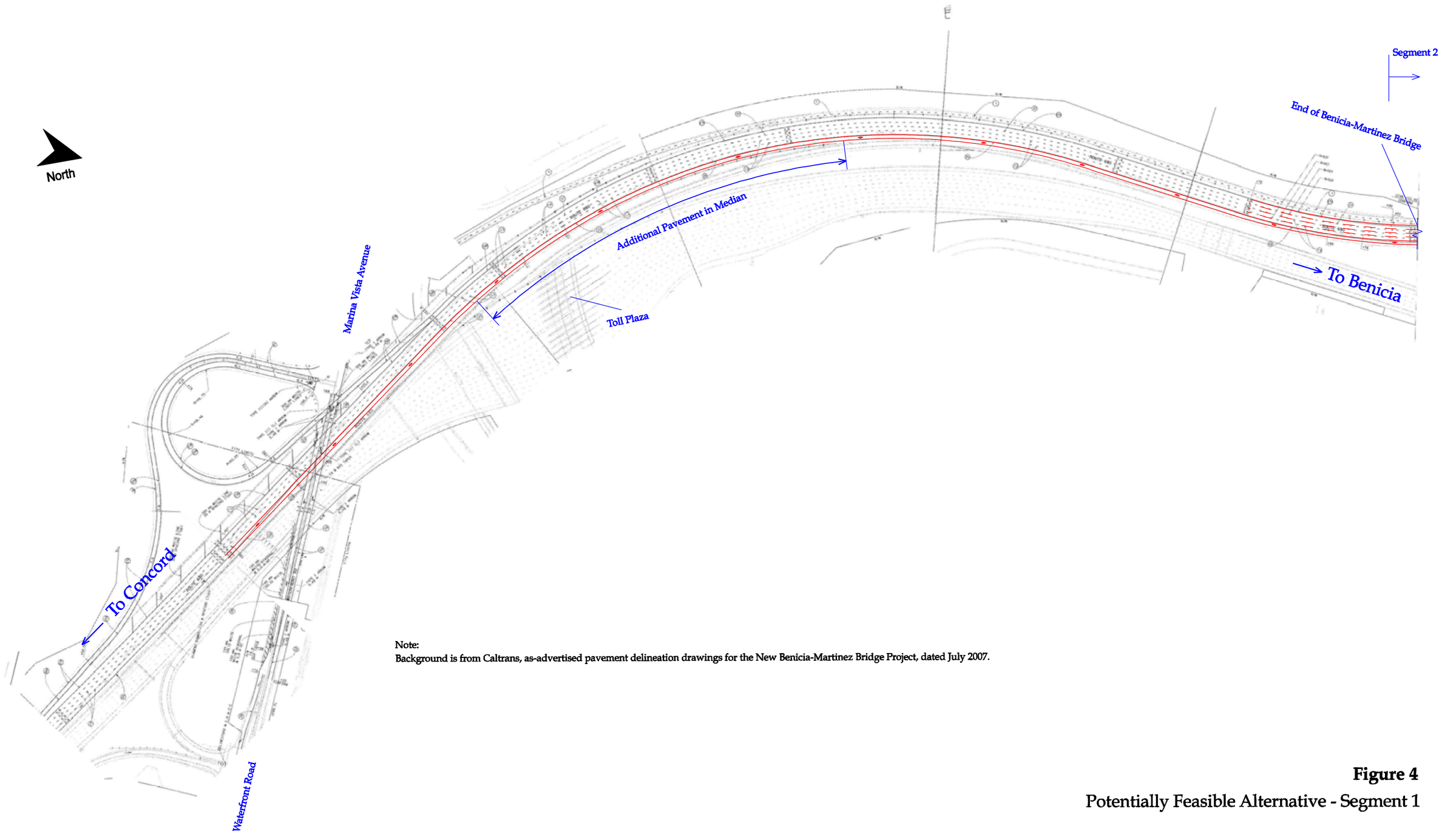
Each potentially feasible alternative described below is not meant to be interpreted as the optimal alternative for each segment. Rather, it is one example of a geometrically feasible alternative. More detailed assessments would be required to incorporate factors such as traffic operations and policy considerations.

Segment 1 - Marina Vista Avenue/Waterfront Road Interchange to South of the Bridge

Under the Baseline Condition, the existing HOV lane starts just to the south of the Marina Vista Avenue/Waterfront Road Undercrossing. The HOV lane could be extended to the north by utilizing the available room in the median. Work would involve re-striping the paved median and pavement widening in the median, while maintaining the mainline lane striping on I-680. Immediately south of the bridge, a lane striping transition would be needed to match the lane configuration on the bridge, as described below in Segment 2. A layout of this potentially feasible alternative is shown in **Figure 4**.

Within the lane striping transition, the lane widths and shoulder widths would be less than the requirements described in the Caltrans Highway Design Manual Sections 301.1 and 302.1. The requirements are 12 feet for all lanes and 10 feet for shoulders for freeways with three general purpose lanes or more. Within the transition area, lane widths would vary between 11 feet and 12 feet, and shoulder widths would vary between 2 feet and 10 feet. Therefore, design exceptions would be required.

FIGURE 3
Study Segments
I-680 Southbound HOV Lane Extentsion



Note:
Background is from Caltrans, as-advertised pavement delineation drawings for the New Benicia-Martinez Bridge Project, dated July 2007.

Figure 4
Potentially Feasible Alternative - Segment 1

Segment 2 - On the Benicia –Martinez Bridge

The HOV lane could be added by re-striping the bridge deck to include an additional 11-foot lane on the left side. This would be consistent with the lane configuration under the Baseline Condition, which includes lane widths of 11 feet and 11.5 feet as shown on **Figure 2**. The left shoulder width would be reduced from 8 feet to 2 feet and the right shoulder width from 8 feet to 3 feet. The 12-foot lane would be maintained on the right for trucks. This alternative would not impact the bicycle/pedestrian facility. The potentially feasible lane configuration on the bridge is illustrated on **Figure 5**. A layout of this potentially feasible alternative is shown in **Figure 6**.

The geometric issue associated with the features described above are non-standard lane widths and shoulder widths, and would require design exceptions. In particular, the reduced shoulder widths would not provide opportunities for emergency shoulder parking on the bridge. However, it should be noted that non-standard lane and shoulder widths are being implemented for the Baseline Condition.

Narrowing the proposed bicycle/pedestrian path and relocating the concrete barrier to the west could allow room to incrementally increase lane and/or shoulder widths on the Benicia-Martinez Bridge. However, full standard lanes and shoulders could only be provided by bridge widening, which would be a very high cost improvement.

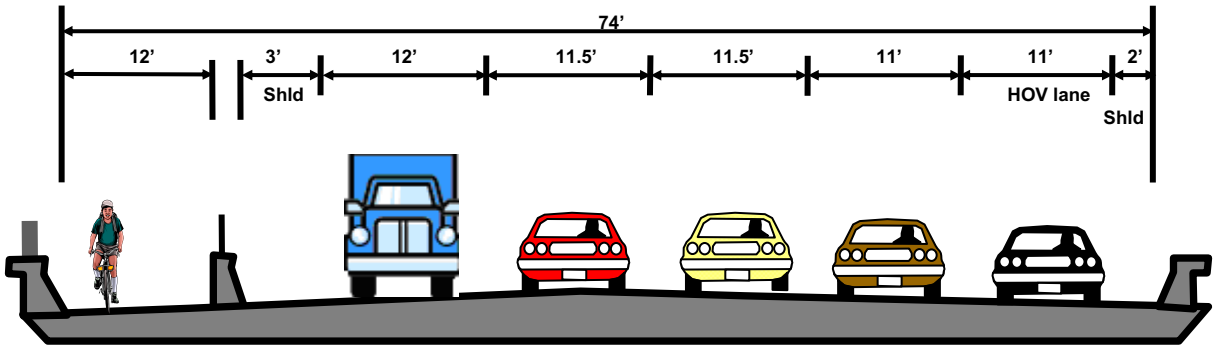


FIGURE 5

I-680 Southbound Cross Section on Benicia-Martinez Bridge

Segment 3 - North of the Benicia-Martinez Bridge to I-780 Interchange

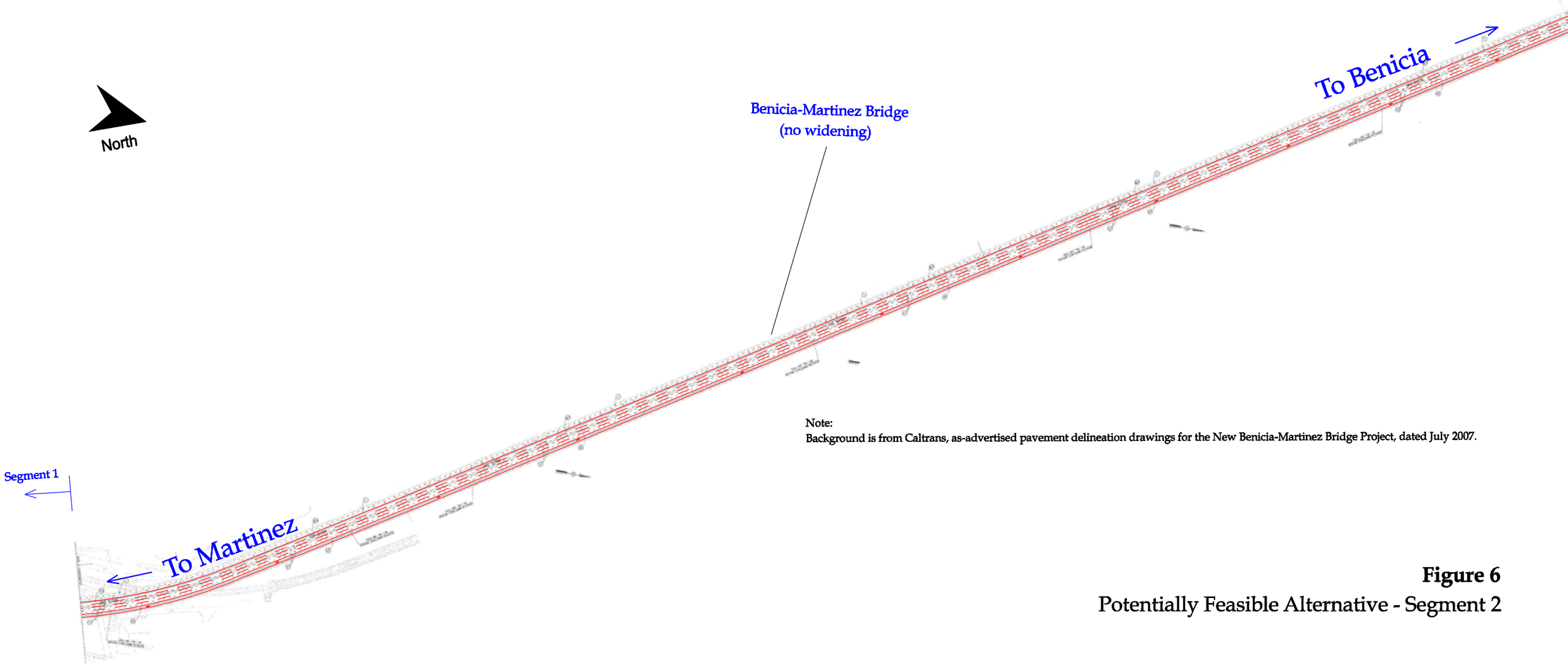
Our geometric review of the Baseline Condition indicated that the HOV lane could be extended north from the Bridge to the undivided section of the freeway, located approximately 0.5 mile south of the Bayshore Road Interchange, by adding pavement in the median or available room within the interchange. In other words, the HOV lane would be added to the left of the existing southbound lanes beginning from approximately 0.5 mile south of Bayshore Road Interchange. The mainline lane configuration would not be impacted.

Immediately north of the bridge, a lane striping transition would be needed to match the lanes on southbound I-680 and the ramp connector from eastbound I-780 with the lanes on the bridge, as described above in Segment 2. Within the transition, the lane widths would be less than the requirements described in the Caltrans Highway Design Manual Sections 301.1 and 302.1. Within the transition area, lane widths would vary between 11 feet and 12 feet. Therefore, design exceptions would be required.

Another geometric issue identified was the reduced width on the right shoulder on the ramp connector from Eastbound I-780, if the proposed bicycle/pedestrian facility and the maintenance road located adjacent to the ramp connector remain at their current location. The right shoulder width would be reduced from 10 feet to 3 feet approaching the Bridge, also requiring a design exception.

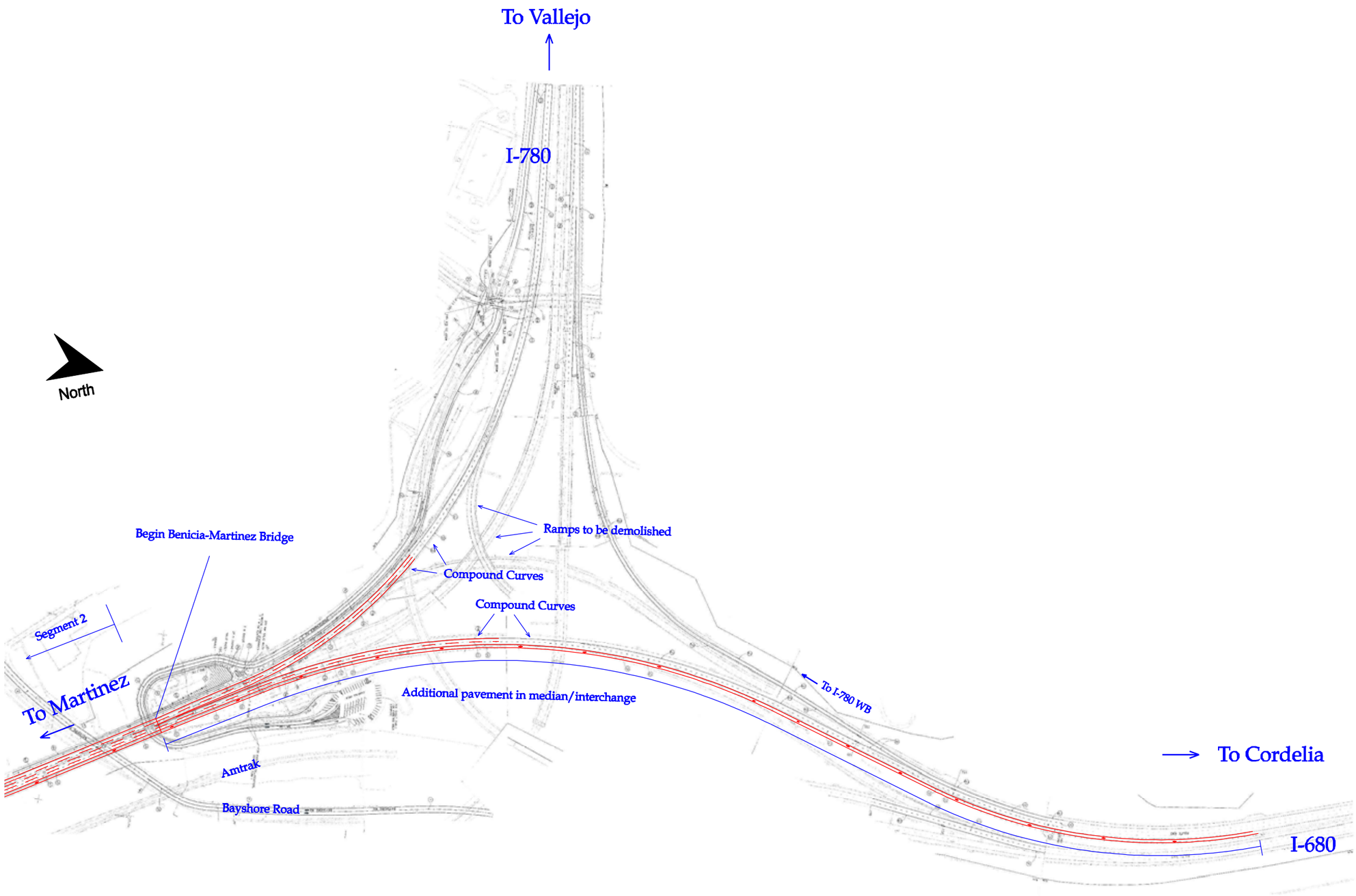
Under the Baseline Condition, the alignment of southbound I-680 mainline is on a simple curve; whereas the alignment of the ramp connector from eastbound I-780 is on a compound curve[1], as defined in the guidelines set forth in Caltrans Highway Design Manual Section 203.5. In the potentially feasible alternative for this segment, the horizontal alignments of both roadways approaching the bridge would need to be modified to match the new lane configuration on the bridge, as described in the discussion under Segment 2. The modified alignment of I-780 would continue to have compound curves. Realignment of southbound I-680 would introduce a new curve with a slightly different radius of curvature than the original curve, thus creating a compound curve. Although the introduction of this compound curve could require a design exception, this potential alternative is considered to be feasible because a compound curve already exists in the interchange. Based on our conceptual layout, the combination of design radii on the compound curves does not appear to require a design exception. A layout of this potentially feasible alternative is shown in **Figure 7**.

[1] A compound curve consists of two simple curves with different radii of curvature curving in the same direction and joined together



Note:
Background is from Caltrans, as-advertised pavement delineation drawings for the New Benicia-Martinez Bridge Project, dated July 2007.

Figure 6
Potentially Feasible Alternative - Segment 2



Note:
Background is from Caltrans, as-advertised pavement delineation drawings for the New Benicia-Martinez Bridge Project, dated July 2007.

Figure 7
Potentially Feasible Alternative - Segment 3

Other Geometric Considerations Identified North of I-780 Interchange

A preliminary assessment indicated that the HOV lane could be extended further to the north of the I-780 Interchange. While the CH2M HILL team did not conduct an extensive assessment of geometric feasibility north of Segment 3, we were able to quickly identify some geometric considerations. From the end of the undivided section of the freeway to the Bayshore Road Interchange, the HOV lane could be added by either: 1) narrowing both the existing left and right shoulders; or 2) widening to the west towards an existing cut slope, which would require significant excavation of materials or construction of retaining walls. The first alternative would require a design exception.

To the north of the Bayshore Road Interchange, southbound I-680 is on a two-lane viaduct structure with a span length of approximately 1,750 feet. The existing shoulder widths on this structure are non-standard and do not provide enough width for an added HOV lane. Extending the HOV lane north across this viaduct would require widening of the entire structure.

4. Conclusions/Next Steps

This issue paper evaluated the geometric feasibility and issues of extending the southbound I-680 HOV lane to the north and across the original Benicia-Martinez Bridge to I-780. Our findings suggest that it is geometrically feasible to extend the HOV lane north and across the Bridge to approximately 0.5 mile south of the Bayshore Road Interchange. There would be no need for new structures, provided that the noted design exceptions are approved by Caltrans. Since non-standard lane and shoulder widths already exist on portions of I-680 in Contra Costa and Alameda Counties where an HOV facility is present, it is reasonable to assume that Caltrans and FHWA would be willing to consider such a proposal on this segment of I-680. The introduction of the compound curve in Segment 3 could also require a design exception; however, the potential alternative is considered to be feasible because a compound curve already exists in the I-680/ I-780 Interchange. In general, design exceptions must be formally documented in fact sheets that are then submitted to Caltrans and FHWA for their approval. Final approval of design exceptions usually occurs during the preparation of the Caltrans Project Study Report and/or Project Report.

Further investigations are recommended to define a project, identify its scope, need and purpose and funding source, as well as its compatibility with other local and regional transportation planning efforts. Other factors such as traffic operations, impact on HOV and transit operations, environmental impacts and policy considerations should be analyzed before an optimal alternative is developed.

Appendix E
Bus Rapid Transit – An Overview of Potential Applicability and Implementation Issues

Issue Paper
Bus Rapid Transit - An Overview of Potential Applicability and Implementation Issues

June 2010

1. Introduction

CH2M HILL is submitting this deliverable as part of Task 7 of the I-680 HOV Express Bus Access Study. This issue paper provides an overview of the potential applicability of Bus Rapid Transit (BRT) in the study corridor and identifies some early implementation issues. Key connection points for the potential BRT routes include the Martinez Amtrak Station, and the Dublin, Pleasant Hill, and Walnut Creek BART stations.

Because BRT is a new concept in the study corridor, CH2M HILL conducted a half-day course on Bus Rapid Transit and other exclusive bus treatments. The course described the range of strategies that are incorporated into BRT and examples of their implementation. Feedback was obtained from the participants regarding priorities for BRT and identification of implementation issues.

2. What is Bus Rapid Transit?

BRT refers to a type of bus transit service that is unique because of its speed and reliability, distinct identity and image, flexibility with respect to fitting into the local context, adaptability, "rail line" type service and quality, and permanence. Some common definitions are:

> "BRT is an enhanced bus system that operates on bus lanes and other transitways in order to combine flexibility of buses with the efficiency of rail. By doing so, BRT operates at faster speeds, provides greater service reliability and increased customer convenience. It also uses a combination of advanced technologies, infrastructure and operational investments that provide significantly better services than traditional bus service." – Federal Transit Administration

> "Bus Rapid Transit (BRT) is an innovative, high-capacity, lower-cost public transit solution that can achieve the performance and benefits of more expensive rail modes. This integrated system uses buses or specialized vehicles on roadways or dedicated lanes to quickly and efficiently transport passengers to their destinations, while offering the flexibility to meet a variety of local conditions. BRT system elements can easily be customized to community needs and incorporate state-of-the-art, low-cost technologies that attract more passengers and ultimately help reduce overall traffic congestion."- National Bus Rapid Transit Institute

BRT is a bus service that mimics Light Rail Transit (LRT). Common features are monitors that display bus schedule, traffic signal priority, easy access for boarding, and widely spaced stops. BRT systems are flexible because they can operate in a broad variety of

physical and operating environments. Segregated and dedicated running ways are preferred for high level BRT lines, but are not required for BRT.

BRT systems typically perform well and result in a significant decrease in transit travel time, increased reliability, improved accessibility, improved safety, and increased capacity. The benefits of BRT include increased ridership from traditional bus transit, improved capital cost effectiveness, improved operating cost effectiveness, improved air quality, and positive effects on land use.

The most critical design parameters for BRT are the ability to safely support rapid, reliable services, provide safe rapid transit vehicle access, and to have a clear identity and favorable aesthetics.

3. BRT Workshop Summary

The goals of this workshop were to establish a common understanding of BRT service and to identify BRT concepts of potential interest in the I-680 corridor. Members of the Central Contra Costa Transit Authority (CCCTA or County Connection) Board were invited as well as the Study Policy Advisory Committee (PAC) and Technical Advisory Committee (TAC) members. There were about 20 attendees in all that included a range of elected officials and agency technical staff.

A facilitated discussion was held with the attendees to identify their understanding of BRT and Enhanced Bus concepts and the issues involved with it. It should be noted that this portion of the discussion was purposely held prior to any information being provided regarding the definition and elements of BRT. The purpose was to be able to customize subsequent discussions to address specific concerns raise. A summary of the attendees initial understanding of BRT and identified issues is provided below.

- BRT service is similar to the one provided along San Pablo Avenue in Berkeley and Oakland. It has a fixed route, priority lane, and traffic signal priority.
- BRT is a bus service that mimics Light Rail Transit (LRT). It has monitors displaying bus schedule, traffic signal priority, easy access for boarding, dedicated lanes, and widely spaced stops.
- BRT is a special bus service that is more flexible than LRT, has its own branding, has fewer stops, and has speed/performance advantage. It need not have a separate Right-of-Way (ROW).
- Enhanced Bus service is same as an Express Bus service.
- Enhanced Bus service has fewer features than a BRT service, involves no major infrastructure changes, and provides reliable service. An example of Enhanced Bus service is the one provided in Curitiba, Brazil.
- Within Central Contra Costa County, BRT service can be provided on Ygnacio Valley Road to serve Walnut Creek BART Station, Clayton Road to serve Concord BART Station, and Contra Costa Boulevard.

- This BRT system should have:
  1. Frequent service and reliable connections.
  2. Bus stops where transfers to/from local transit and other transit modes are feasible. The tranfers should be smooth, possibly using a single ticket for all modes of transportation.
  3. Branding
  4. An easy payment system that is clearly mentioned on the bus. Prepaid ticket is an example of the payment system that can be pursued.
- Issues faced for the implementation of a BRT service includes:
  1. Availability of funds
  2. Lack of ROW
  3. Political/public resistance offered due to inconsistency with land use policies and proximity of BRT service ROW to individual properties
  4. Resistance from merchants to avoid loss of business, similar to that offered against BRT service proposal on Telegraph Avenue in Oakland and Berkeley
  5. Perception of inducing sprawl
  6. Provision of efficient transit connections
  7. Provision of access to BRT, including parking facilities
  8. Loss of parking on BRT corridor
  9. Perceived impact to traffic flow
  10. Attracting new riders from different modes of transportation by making it attractive and faster than the traffic
  11. Provision of on-board safety
  12. Availability for special events

With this background understanding of the attendees perspectives, a presentation was provided related to BRT concepts, advantages, disadvantages and examples. A question-and-answer session was then held regarding the attendees opinions and concerns about BRT and its potential implementation in Central Contra Costa County. The following questions/issues/concerns were identified:

- What existing conditions of a community, including land use, transit origin and destination, traffic congestion, and transit ridership are required to make a BRT successful?
- The BRT operation in Central Contra Costa County can be started by testing it along a small corridor. Ygnacio Valley Road from Clayton Road to the Walnut Creek BART Station is a good test corridor.

- The corridor along Contra Costa Boulevard serving the cities of Martinez, Walnut Creek, and San Ramon along with Dublin BART Station is suitable for trunkline service.
- To implement BRT service in the Central Contra Costa County, travel market analysis is needed to identify the origin/destination locations and to support multiple transit modes.
- Parking for BRT service can be provided at shopping centers and churches. However, liability will be an issue. Research on providing liability insurance was performed by a state Department of Transportation (DOT).

In further, small group discussions, some of the key topics and guidance that were raised are summarized below.

- Corridor along Pacheco Boulevard/Contra Costa Boulevard/North Main Street/San Ramon Valley Boulevard is designated as a Trunkline Corridor in Contra Costa County Regional Transportation Plan (CCCRTP).
- The corridors along which BRT system might be tried in the Central Contra County are:

  1. Ygnacio Valley Road
  2. Contra Costa Boulevard/Pacheco Boulevard/North Main Street
  3. Corridor connecting Ygnacio Valley Road, Mount Diablo, Lafayette, and Orinda
  4. Pleasant Hill Road
  5. Danville Boulevard/Hertz Avenue/San Ramon Valley Boulevard/San Ramon Road
  6. Treat Boulevard/Bailey Road between Pleasant Hill and Bay Point BART stations.

- The level of BRT service provided can vary within a route.
- Potential BRT service stops along Ygnacio Valley Road include Walnut Creek BART Station, Downtown Walnut Creek, Shadelands, John Muir Hospital, Sequoia Surgical Pavilion, Clayton Road, and Railroad BART Station.
- BRT service along Ygnacio Valley Road should be coordinated with the BART trains and connected to the Shadelands using a shuttle.
- Potential BRT service stops along Contra Costa Boulevard/Pacheco Boulevard/North Main Street include Lesher Center for the Arts, Sun Valley Mall, Diablo Valley College, county offices, Martinez Amtrak Station, Downtown Pleasant Hill, Downtown Walnut Creek, Downtown Concord (using a connection), Kaiser Permanante Walnut Creek Medical Center, Contra Costa Centre, Pacheco Transit Hub (using a connection), and multiple retail sites.
- Potential BRT service stops along Danville Boulevard/Hertz Avenue/San Ramon Valley Boulevard/San Ramon Road include Bishop Ranch Center, San Ramon Transit Center, Downtown Danville, Sycamore Valley Road Park and Ride Lot, and Dublin BART Station. To include Bollinger Canyon Road and Dougherty Road as BRT stops, Southwest Area Transportation Committee (SWAT) should be consulted.
- Classes should be organized at civic events to teach senior citizens and students how to use the BRT bus.
- For branding of the BRT buses, red color is more noticeable.

4. Preliminary Candidate Corridors

There were six corridors identified as potential candidates for BRT service in Central Contra Costa. At this point, there is no priority ordering of the corridors. The description provided in this section provides an overview of the potential applicability for BRT and identifies early implementation issues. A more complete BRT feasibility study would be required before proceeding with any detailed recommendations.

Contra Costa Boulevard/ Pacheco Boulevard/ North Main Street

This corridor is designated as a Trunkline Corridor in the Contra Costa County Regional Transportation Plan (CCCRTP). Historically, this corridor has been served by multiple transit lines and would require riders to make multiple transfers between key county destinations such as the county seat in Martinez and the shopping areas in downtown Walnut Creek. This corridor serves many popular destinations in Central Contra Costa.

Potential Bus Stop Locations

- County offices in Martinez
- Martinez Amtrak Station
- Pacheco Transit Hub
- Diablo Valley College
- Sun Valley Mall
- Downtown Pleasant Hill
- Contra Cost Centre
- Downtown Walnut Creek
- Lesher Center for the Arts
- Kaiser Permanante Walnut Creek Medical Center
- Various retail sites

Constraints/ Implementation Issues

- Design of BRT could result in the removal of on-street parking along Court Street, Pine Street, Jones Street, and segments of Pacheco Boulevard and Contra Costa Boulevard.
- No available right-of-way roadway expansion on Main Street.
- Possible resistance from merchants located on Contra Costa Boulevard and North Main Street.

Treat Boulevard/ Bailey Road between Pleasant Hill and Bay Point BART Stations

BRT in this corridor would provide higher quality transit access to and from the Pleasant Hill and Bay Point BART Stations.

Potential Bus Stop Locations

- Bay Point BART Station
- Treat Boulevard/ Clayton Road
- Treat Boulevard/ Oak Grove

- De La Salle and Carondelet High Schools
- Treat Boulevard/ Bancroft
- Pleasant Hill BART Station

Constraints/ Implementation Issues

- Limited right-of-way available for roadway expansion on Treat Boulevard south of Navaronne Way.
- Ridership may not be as high on this corridor since the main destinations would be to the BART stations, and there is high quality transit service between the BART stations.

Pleasant Hill Road/ Taylor Boulevard between downtown Pleasant Hill and Lafayette BART Station

BRT in this corridor would provide high quality transit access to and from the Pleasant Hill and Lafayette BART Stations. A direct transit connection would also be provided between downtown Pleasant Hill and downtown Lafayette.

Potential Bus Stop Locations

- Pleasant Hill BART Station
- Downtown Pleasant Hill
- Palos Verdes Mall
- Acalanes High School
- Lafayette BART Station
- Downtown Lafayette

Constraints/ Implementation Issues

- Portions of Geary Road are viewed as a residential roadway.
- With the high quality transit service between the BART stations, would need to carefully examine the ridership potential.

Corridor connecting Ygnacio Valley Road, Mt. Diablo Boulevard, Lafayette and Orinda

This BRT corridor would provide a connection between the major shopping and employment centers in Walnut Creek and the downtown areas of Lafayette and Orinda.

Potential Bus Stop Locations

- Walnut Creek BART Station
- Downtown Walnut Creek
- East end of Downtown Lafayette
- Downtown Lafayette/ Lafayette BART Station
- Acalanes Road/ El Nido Ranch Road (Bentley High School)
- Altarinda Road/Orinda Way
- Downtown Orinda/ Orinda BART Station

Constraints/ Implementation Issues

- Design of BRT could result in the removal of on-street parking along Mount Diablo Boulevard, Camino Diablo Road, Old Tunnel Road, and California Boulevard.
- Possible resistance from merchants located on Mount Diablo Boulevard, Camino Diablo Road, Old Tunnel Road, and California Boulevard.
- Connection between Lafayette and Orinda is along arterials that are considered residential streets.

Ygnacio Valley Road between Oak Grove Road and the Walnut Creek BART Station

The primary goal of an Ygnacio Valley Road BRT corridor would be to serve the Walnut Creek BART station.

Potential Bus Stop Locations

- Ygnacio Valley Road/ Oak Grove Road
- Shadelands
- John Muir Hospital
- Downtown Walnut Creek
- Walnut Creek BART Station

Constraints/ Implementation Issues

- Existing roadway between Oakland Boulevard and Walnut Avenue has extremely limited right-of-way. This portion of the roadway has no shoulders or room for expansion. Buses would need to stop in the travel lanes.
- Bus stops on this route would significantly, negatively impact the traffic operations on Ygnacio Valley Road, which is one of the most congested arterials in Central Contra Costa.
- May not attract many additional riders, since County Connection operates Route 93X along the same corridor.

Danville Boulevard/ Hartz Avenue/ San Ramon Valley Boulevard/ San Ramon Road

BRT in this corridor would provide high quality transit service between the Walnut Creek BART Station and the West Dublin BART Station. This connection is not well served by BART. Major residential and employment centers would be connected in this corridor

Potential Bus Stop Locations

- Walnut Creek BART Station
- Downtown Walnut Creek
- Downtown Danville
- Sycamore Valley Road Park-and-Ride Lot
- San Ramon Transit Center/ Bishop Ranch
  West Dublin BART Station

Constraints/ Implementation Issues

- Design of BRT could result in the removal of on-street parking along California Boulevard and San Ramon Valley Boulevard. Also, in downtown Danville.
- Possible resistance from merchants located along the corridor.
- No right-of-way available for roadway expansion on San Ramon Road near Dublin.

5. Conclusions

BRT is potentially applicable and feasible in the I-680 study corridor. A number of preliminary candidate corridors were identified in Central Contra Costa. Each of these corridors serves major residential, employment, educational and/or retail centers. Linkage of potential BRT corridors with BART stations provides a regional transit link.

For each of the preliminary candidate corridors, there are a number of constraints and implementation issues. Right-of-way constraints, potential impact to on-street parking and possible resistance from local merchants were common issues identified. More information and outreach is needed to determine how best to address these issues.

This issue paper and the preceding BRT workshop are first steps in adding BRT to the range of transit options that can be explored in Central Contra Costa. To further develop BRT concepts and refine the understanding of its applicability, more study is required to estimate potential ridership impacts, estimate cost of construction and evaluate overall feasibility.