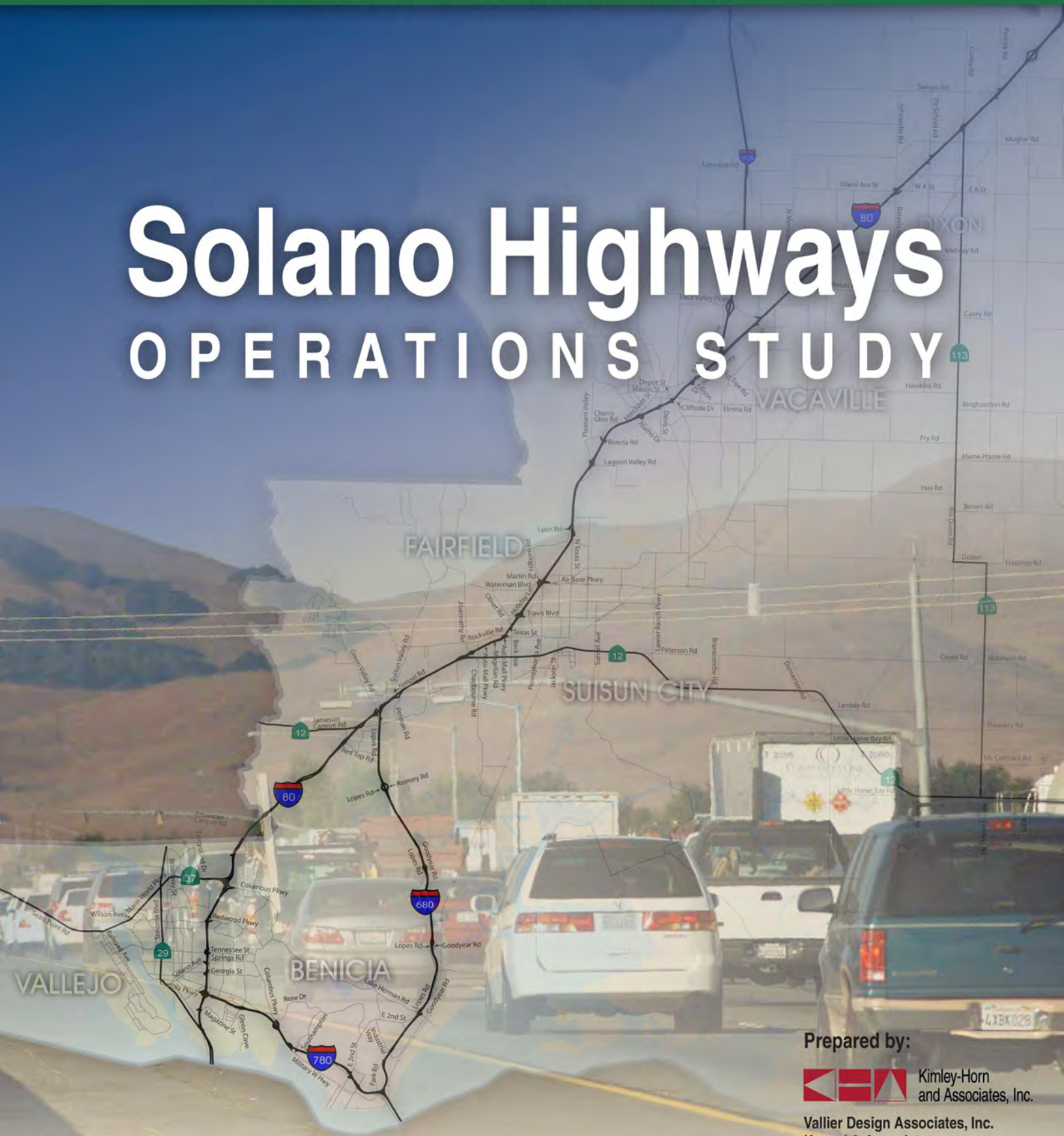
FINAL REPORT

Solano Highways
OPERATIONS STUDY



Prepared by:

Kimley-Horn and Associates, Inc.

Vallier Design Associates, Inc.
Koegel & Associates
DKS Associates

February 22, 2010

Prapared for:

Solano Transportation Authority

And the Solano Highways Partnership:

Caltrans · MT · SACOG · Benicia · Vacaville · Vallejo · Fairfield · Dixon · Solano County

Acknowledgments

This report was made possible by a Partnership Planning Grant
awarded by the California Department of Transportation.

Solano Transportation Authority
Board of Directors
Jim Spering, Chair, County of Solano
Pete Sanchez, Vice Chair, City of Suisun City
Elizabeth Patterson, City of Benicia
Jack Batchelor, Jr., City of Dixon
Harry Price, City of Fairfield
Jan Vick, Chair, City of Rio Vista
Len Augustine, City of Vacaville
Osby Davis, City of Vallejo

Technical Advisory Committee members
Charlie Knox, City of Benicia
Royce Cunningham, City of Dixon
Gene Cortright, City of Fairfield
Morrie Barr, City of Rio Vista
Dan Kasperson, City of Suisun City
Rod Moresco, City of Vacaville
Gary Leach, City of Vallejo
Paul Wiese, County of Solano

Solano Highways Partnership (SoHIP) Committee
Dan Schiada, City of Benicia
Janet Koster, City of Dixon
Wayne Lewis, City of Fairfield
Paul Wiese, County of Solano
Jeff Knowles, City of Vacaville
Gary Leach, City of Vallejo
Erik Alm, Caltrans District 4
Jeanne Gorham, Caltrans District 4
Alan Chow, Caltrans District 4
Cesar Pujol, Caltrans District 4
Richard Helman, Caltrans District 3
Matt Carpenter, SACOG
Samson A. Okhade, SACOG
Jaime Maldonado, MTC

Landscape/Hardscape Subcommittee
Dan Shiada, City of Benicia
Jeanne Gorham, Caltrans District 4
Janet Koster, City of Dixon
Brian Miller, City of Fairfield
Erin Beavers, City of Fairfield
Wayne A. Lewis, City of Fairfield
Paul Wiese, Solano County
Missy Borel, UC Davis California Center for Urban Horticulture
Jim Irvine, City of Vacaville
Shawn Cunningham, City of Vacaville

MTC staff
Albert Yee, Director, Highway and Arterial Operations
Joy Lee, Senior Program Coordinator
Mike Kerns, Senior Program Coordinator

Caltrans staff
Cameron Oakes, Caltrans District 4
Joseph Aguilar, Caltrans District 4
Adrian Levy, Caltrans District 4
Bill Tournay, Caltrans Headquarters

Solano Transportation Authority Staff
Daryl Halls, Executive Director
Janet Adams, Director of Projects
Sam Shelton, Project Manager

Kimley-Horn and Associates
Anush Nejad, Principal
Kevin Aguigui, Project Manager
Kevin Thomas, Project Engineer
Alyssa Phaneuf, ITS Engineer
Kalai Kubendran, Assistant Engineer
Kao Saeturn, Graphics

Vallier Design and Associates
Marcia Vallier, President
Aimee Ruskewicz, Planner
Christina Jirachachavalwong, Planner

Koegel and Associates
Joanne Koegel, President

DKS Associates
Terry Klim, Principal
Paul Stanis, Assistant Engineer

Contents

List of Figures

List of Tables

List of Exhibits

1. PROJECT BACKGROUND

The STA's planning, programming and project delivery duties are guided by the STA's Comprehensive Transportation Plan (CTP), which plans for all forms of transportation and prioritizes projects, identified in the following CTP plan elements:

- Arterials, Highways and Freeways
- Transit
- Alternatives Modes

Using the goals of the CTP for direction, STA staff completed studies and plans to identify priority transportation projects that will achieve those goals. The goal of the Arterials, Highways, and Freeways element is to "*Develop a balanced transportation system that reduces congestion and improves access and travel choices through the enhancement of roads*".

Caltrans annually provides grant opportunities through the State Transportation Planning Grant program for several categories including a Partnership Planning Grant where corridor studies are eligible. The STA has completed the I-80/I-680/I-780 Corridors Study Highway Operations Plan to follow up on the STA's previous I-80/I-680/I-780 Corridor Major Investment and Corridor Study (2004) and MTC's Freeway Performance Initiative (FPI) (2007). The I-80/I-680/I-780 Corridors Study Highway Operations Plan was developed cooperatively under the direction of the Solano Highways Partnership (SoHIP) consisting of representatives from STA, MTC, Caltrans (Districts 3 and 4), and the cities of Benicia, Dixon, Fairfield, Vacaville and Vallejo. Under this study, operational improvements and recommendations for a long range Intelligent Transportation System (ITS) including ramp metering, closed circuit television cameras (CCTV), vehicle detection and highway advisory radios are presented.

2. BACKGROUND RESEARCH AND LITERATURE REVIEW

This section identifies the key elements that are to be included in the Memorandum of Studies and ITS Technologies report as part of the Task 3 – Background/Research for the Solano Highways Operations Study.

2.1 Purpose

The primary purpose of this document is to conduct a review of the existing studies that will influence or provide relevant materials and/or information in the development of the Solano Highways Operations Study. It is understood that there have been many studies prepared and that each study may address portions of the goals and objectives of the Solano Highways Operations Study, and identifying those areas will serve to incorporate the recommendations and next steps from the existing studies. One note is that Solano Highways Operations Study will support the development of the Caltrans Corridor System Management Plan (CSMP) for SOL-80.

Another purpose of this study is to briefly describe some of the ITS technologies that are available or are under development. As part of the Solano Highways Operations Study, a Corridor-Level ITS Architecture and Implementation Plan will be developed and these ITS technologies will be considered as part of that Plan.

2.1.1 Existing Studies and Reports

This section provides a summary of that literature review and provides a brief summary of each study or report and its relevance for the Solano Highways Operations Study. The literature review includes relevant guidelines, projects or improvements that are recommended in each study as it is applicable to the project.

Based on an initial set of documents identified by the STA and on comments from the Partnership, the existing studies and reports listed below were reviewed.

1. MTC's Freeway Performance Initiative - I-80 (2007) and I-680[1]
2. I-80/680/780 Major Investment Study & Corridor Study (2004)
3. Caltrans Traffic Operations System (TOS) Implementation Plan (2002)
4. I-80 Cordelia Truck Scales Relocation Study (2005)
5. Bay Area Regional ITS Architecture (2007)
6. California Statewide ITS Architecture (2004)
7. Caltrans Corridor System Management Plan Guidelines and draft papers (2009)
8. MTC Regional Transportation Plan (T2030 and T2035 draft vision) (2008)
9. Comprehensive Transportation Plan (2004 + current draft in progress).
10. I-80/I-680/I-780 Transit Corridor Study (2004)
11. SR 12 Major Investment Study (MIS) conducted by STA (2001)
12. MTC's HOV Master Plan (2003)
13. Bay Area Regional HOT Lane Network Study (2007)
14. FHWA's Active Traffic Management: The Next Step in Congestion Management (2007)
15. WCCTAC/ACCMA Integrated Corridor Mobility Project – I-80 ICM ((2006)
16. SR-113 Major Investment & Corridor Study (2009)
17. I-80 Smarter Growth Study (2007 - draft)
18. Governor's Strategic Growth Plan/Go California Initiative (2008)

Some of these documents are in draft form, therefore due to the timeline of this review, the summary of findings may be based on information that will be subject to change depending on the state of each of the studies and/or reports.

2.1.2 Summary of Findings

This section will summarize the findings of the review of the existing reports and documents. The summary will recommended operational improvements and ITS technologies, concepts and deployments that are in the studies and reports.

This section summarizes the identified and recommended operational improvements along the study corridors documented in the existing studies and reports.

[1] The I-680 FPI Study was not finalized.

2.1.2.1 MTC's Freeway Performance Initiative (I-80 and I-680)

The I-80 Mitigations Report final version was the only report published by MTC as of this writing. The I-680 FPI report was not finalized and at the time was still evaluating the future conditions and the recommended mitigations. Therefore, only the I-80 FPI is discussed herein.

I-80 Freeway Performance Initiative

This memorandum presented an analysis of the I-80 corridor for two future scenarios: 2015 and 2030. The study defined the short-term to be from 2007 to 2015 and the long-term from 2016 to 2030. The analysis identified mitigation strategies to address congestion and included capacity improvements (additional lanes, HOV facilities), operational improvements (auxiliary lanes and interchange modifications) and transportation management strategies (ramp metering, changeable message signs, etc.) along I-80 in Solano County for both the short and long term scenarios.

The mitigation strategies were grouped into packages that are based on either individual projects or logical groupings of projects. Prioritization of the strategies within the short and long-term categories is complete.

Committed Improvements on the I-80 Corridor

The study incorporated only the fully funded improvement projects which would significantly affect 2015 and 2030 operations. There were a total of four such projects:

- EB/WB I-80 HOV lanes from SR 12 West/Red Top Road to Air Base Parkway (to be completed in 2009);
- SR 12 West Truck Climbing Lane Project (constructed in 2008);
- Widening of SR 12 from SR 29 to I-80 (Jameson Canyon Project); and
- WB I-80 Auxiliary Lane from Monte Vista Avenue to I-505.

A Future Conditions Technical Memorandum identified the queues and bottlenecks for the future scenarios (2015 and 2030) with these improvements in place. From there, a set of mitigation strategies were identified to accommodate the future queues and bottlenecks.

Short-term Mitigation Strategies (2007 – 2015)

Short-term Strategies Package A

This package is to deploy ITS technologies on I-80 throughout Solano County. For the purposes of this recommendation, ITS deployment included the installation and operation of closed circuit television (CCTV) cameras, traffic detection and changeable message signs. The goal of this strategy is to reduce non-recurrent congestion along I-80 in Solano County. This package included the following:

- Assess gaps in the current and programmed ITS installations and supplement as needed. (i.e. between SR 29 and SR 37 in Vallejo and from Red Top Road to Air Base Parkway)
- Extend ITS coverage to fill the gap between SR 37 and Red Top Road
- Extend ITS coverage eastward from Air Base Parkway to the Solano / Yolo County Line

This package is consistent with the recommendation for a traffic management plan for I-80 identified in the I-80/680/780 MIS.

Short-term Strategies Package B

This package will address existing and projected capacity /operational deficiencies between Travis Boulevard and Alamo Drive. In 2015, these deficiencies were primarily focused in the eastbound direction of travel. To address these deficiencies a combination of capacity enhancements, operational improvements and transportation management measures were recommended as follows:

- Extend the eastbound HOV-2 lane (Traffic projections indicate this project is needed in 2012) from Air Base Parkway to Alamo Drive.
- Install ramp metering on local service interchanges (eastbound and westbound) between Air Base Parkway and Alamo Drive.
- Provide an eastbound auxiliary lane between Travis Boulevard and Air Base Parkway. This was identified as a medium-term improvement in the I-80/680/780 MIS.
- Provide an eastbound auxiliary lane between Pleasant Valley Road and Alamo Drive with a two-lane off-ramp at Alamo Drive.

Short-term Strategies Package C

This package consists of implementing transportation management strategies in the I-680 / I-80 / SR 12 Interchange area. These strategies which include ramp metering and improvements to the signalized intersection(s) on SR 12 East will optimize operations on this critical section of I-80. The recommendations included:

- Install ramp metering at the Green Valley Road and Suisun Valley Road interchanges.
- Provide additional eastbound capacity (the equivalent of one, eastbound through lane) at the intersection of SR 12 East and Beck Avenue.

Long-term (2016 – 2030) Mitigation Strategies

Long-term Strategies Package D

This package will address projected capacity /operational deficiencies between SR 29 and SR 37. The recommended mitigation strategy is to extend the HOV lane to SR 37 which would provide an HOV bypass for the queue that is created by this bottleneck. The following specific measures were recommended as part of this package of improvements for I-80 in this area.

- Conduct a comprehensive evaluation to identify and improve geometry and access between SR 29 and SR 37 in both directions by consolidating / removing access points, and improving merge and diverge areas.
- Install ramp metering in both directions at local access interchanges in Vallejo between SR 29 and SR 37
- Extend the westbound HOV-3 lane from the Carquinez Bridge to east of the SR 29 westbound on-ramp. This was identified as a long-term improvement in the I-80/680/780 MIS.
- Extend the fourth eastbound general purpose lane from the SR 29 off-ramp to the Sequoia Avenue off-ramp.

- Provide an eastbound auxiliary lane between the Tennessee Street on-ramp and the Redwood Street off-ramp. This was identified as a long-term improvement in the I-80/680/780 MIS.
- Provide an eastbound auxiliary lane between the I-780 on-ramp and the Georgia Street off-ramp. This was identified as a long-term improvement in the I-80/680/780 MIS.
- Extend the westbound HOV-3 lane from east of the SR 29 westbound on-ramp to SR 37.

Long-term Strategies Package E

This package will implement major improvements at the I-680 / I-80 / SR 12 interchange area. The key components of this set of improvements includes improving access capacity to and from I-680, implementing modifications to the truck scales and /or a relocation of these facilities, and addressing the weaving and access issues between SR 12 West and the I-680 interchange. Several configurations were studied to improve this interchange and the determination of the specific configuration should be recommended through these interchange specific studies.

While the interchange area improvements were listed here as long-range strategies, it was noted that the volumes on I-80, I-680 and SR 12 were projected to be at levels that justify investment along this section of I-80 in the 2016-2017 timeframe. For the purposes of this package of improvements the following was recommended:

- Improve the I-680 interchange connections to address the capacity deficiencies, geometry and spacing of these ramps by either modifying the current interchange geometry on implementing an alternative configuration.
- Provide auxiliary lanes and braided ramp configurations as necessary between I-680 and SR 12 East and adjust truck scales location within the same general area to improve weave and merge maneuvers. This was identified as a medium-term improvement in the I-80/680/780 MIS and the Truck Scales Relocation Feasibility Study.
- Provide auxiliary lanes and braided ramp configurations as necessary between SR 12 West and I-680 to improve weave and merge maneuvers. This was identified as a medium-term improvement in the I-80/680/780 MIS and the Truck Scales Relocation Feasibility Study.
- Provide additional mainline capacity in both directions. Between SR 12 West and I-680 the section should include five general use lanes plus one HOV-2 lane in each direction. The section between I-680 and SR 12 East should have six general purpose lanes, plus one HOV-2 lane in each direction.

Long-term Strategies Package F

This package will provide additional capacity and address operations to the east of the I-680 / I-80 / SR 12 Interchange area and is directed towards improving capacity upstream in the westbound direction of travel and downstream in the eastbound direction of travel so that the investment in the interchange area is not negated by congestion and queues caused by bottlenecks on I-80 east of the interchange complex. The recommendations for this package were:

- Provide a fifth eastbound general purpose lane extending from SR 12 East to Air Base Parkway while maintaining the existing auxiliary lane between Abernathy Road and West Texas Street.
- Provide a fifth westbound general purpose lane from SR 12 East to West Texas Street.

- Provide a westbound auxiliary lane between Travis Boulevard and Air Base Parkway
- Provide a westbound auxiliary lane between Air Base Parkway and North Texas Street.

Long-term Strategies Package G

This package will address eastbound capacity and operational improvement needs between Alamo Drive and I-505 and includes an extension of the HOV-2 lane, auxiliary lanes and ramp metering between Alamo Drive and I-505. Specifically, this package included:

- Extend the eastbound HOV-2 lane from Alamo Drive to I-505
- Install ramp metering at all eastbound local service interchanges between Alamo Drive and I-505.
- Provide an eastbound auxiliary lane between Cliffside Drive and Allison Drive with a two-lane off-ramp at Allison Drive.
- Provide an eastbound auxiliary lane between Cherry Glenn Road and Pleasant Valley Road.

Long-term Strategies Package H

This package will address westbound capacity and operational improvement needs between Air Base Parkway and I-505. It included:

- Extend the westbound HOV-2 lane from Air Base Parkway to I-505
- Install ramp metering at all westbound local service interchanges between Alamo Drive and I-505
- Provide a westbound auxiliary lane between Pleasant Valley Road and Alamo Drive.

Long-term Strategies Package I

This package will address westbound capacity and operational needs east of I-505 and includes additional mainline capacity in the eastbound direction of travel and the provision of ramp metering for the balance of the I-80 study corridor. Specifically,

- Provide a fourth eastbound general purpose lane extending from Leisure Town Road to Kidwell
- Install ramp metering at westbound local access interchanges from I-505 eastward to the Solano / Yolo County Line.

Long-term Strategies Package J

This set of strategies addresses gaps in either HOV lanes and/or general use lanes on I-80 in Solano County. It was noted that each of these improvements needed to be evaluated separately, but were not needed from the standpoint of congestion relief along the corridor, but instead needed to be assessed to determine the benefit of lane continuity along the I-80 corridor and the ultimate completion of the corridor, which may extend beyond the 2030 analysis period, needed to be assessed. The gap projects included:

- Provide an eastbound HOV lane from SR 29 to SR 37.
- Provide eastbound and westbound HOV lanes from SR 37 to Red Top Road
- Provide a fourth westbound general use lane between Leisure Town Road and Kidwell

Summary

This study provided the most recent operational set of improvements along the I-80 Corridor in Solano County. The short term improvements focused on the eastbound direction in the PM Peak Period which was forecast to remain the bottleneck direction until 2015. In addition, aside from the physical improvements recommended for both the short and long term, operational improvements were recommended including ramp metering.

One operational strategy that was not specifically assessed was the viability of HOT lanes, which may provide some form of congestion relief during the peak periods while providing a financing mechanism for some of the physical and operational improvements.

The short-term strategies that includes the deployment of ITS technologies was addressed as part of the Corridor-Level ITS Architecture (see Section 4). These included the following:

- Assess gaps in the current and programmed ITS installations and supplement as needed. (i.e. between SR 29 and SR 37 in Vallejo and from Red Top Road to Air Base Parkway)
- Extend ITS coverage to fill the gap between SR 37 and Red Top Road
- Extend ITS coverage eastward from Air Base Parkway to the Solano / Yolo County Line

The Corridor-Level ITS Architecture evaluated these recommendations further and provided more details on implementation segments and integration with the existing Freeway Traffic Operations System.

2.1.2.2 Caltrans Corridor System Management Plan Guidelines and draft papers

I-80 East CSMP (District 4)

The I-80 East Corridor System Management Plan is currently being prepared by District 4. As of this writing, the report is not available for review. However, it is anticipated that the recommendations of this CSMP will be consistent with the I-80 Freeway Performance Initiative recommendations as well as the recommendations of this report.

I-80 CSMP (District 3)

The I-80 CSMP in District 3 addresses the portion of I-80 that begins at the I-80 and SR 113 interchange in Solano County and ends at the I-80/Sierra College Boulevard Interchange in Placer County. It also addresses SR51 (Business 80 and Capital City Freeway) that begins at the interchange with U.S. 50/SR 99 and ends at the junction with I-80. This CSMP has been completed and the final document can be viewed and downloaded at Caltrans' website: www.corridormobility.org.

The overall length of the two highways addressed in this plan is about 48 miles. The portion of I-80 and SR 51 that are being addressed in this CSMP are currently experiencing high levels of traffic congestion, particularly in the South Placer and Sacramento County areas.

I-80 is the main State Highway within this CSMP corridor proposed for inclusion in the CSMP transportation network. Additionally, there are other State Highways within the I-80 CSMP Transportation Network that are located roughly parallel to the corridor or serve as an official alternative route in case of a natural disaster or national security emergency. These parallel highways include SR 160 from the American River Bridge to SR 51 in the City of Sacramento, I-5 from I-80 in the City of Sacramento to SR 113 in the City of Woodland, and SR 113 from I-5 to I-80 in next to the City of Davis. Along with State Highways, additional modes and roadways are proposed for inclusion into the CSMP transportation network and must satisfy the following criteria:

- Provide for mobility within or through the boundaries of this I-80 CSMP corridor,
- Major roadways, which:
  - Provide capacity for corridor travel and are located roughly parallel to the State Highway in urban areas,
  - Provide a realistic alternative for vehicle trips, which would predominantly use the State Highway were the roadway not available,
  - Connect major parallel arterials included as part of the CSMP network with the State Highway,
  - Primarily provide mobility between major activity centers, and
  - Have carrying capacity or throughput, or have potential to add capacity.
- Transit and rail routes, which provide regularly scheduled service between major activity centers,
- Bicycle routes and facilities, which provide for biking opportunities roughly parallel to the State Highway and key crossings of freeways, and
- The transportation mode or roadway could potentially be integrated into the coordinated corridor management system.

Summary

The District 3 portion of the I-80 CSMP was finalized in mid-2009, and the development of the I-80 East CSMPs is still a work in progress. However, it is anticipated that this Solano Highways Operations Study will establish a tie in with the I-80 District 3 CSMP at the Solano County border. Also, it is anticipated that the recommendations put forth from the I-80 FPI study will provide the basis for both the I-80 District 4 CSMP and the Solano Highways Operations Study.

2.1.2.3 I-80/680/780 Major Investment Study & Corridor Study

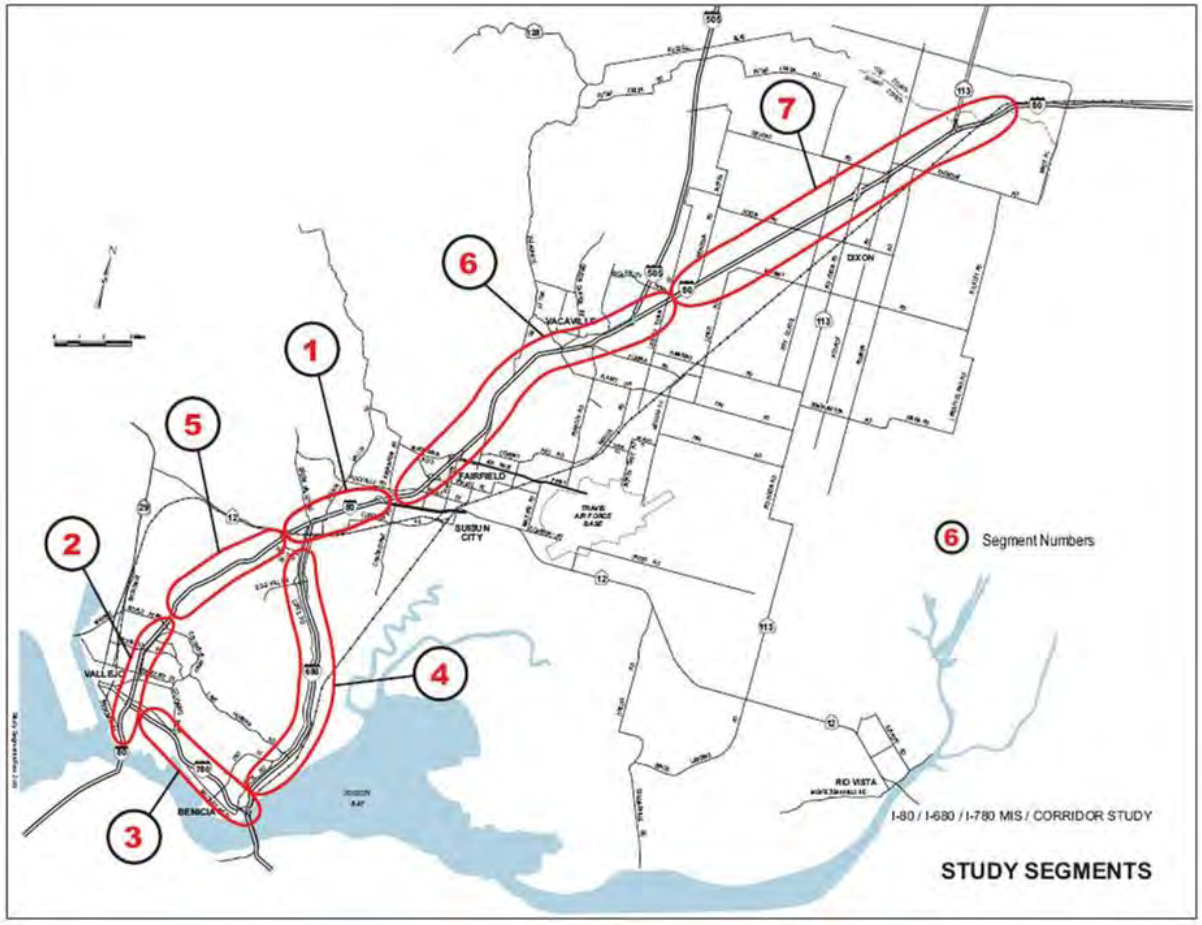
The goal of the I-80/I-680/I-780 Major Investment and Corridor Study was to develop a long range, multi-modal corridor transportation plan for the I-80, I-680 and I-780 corridors in Solano County. The map below, taken from the study, illustrates the segment boundaries that were evaluated under the study.

The improvements identified within each segment were categorized into near, medium and long term improvements. Listed below was a summary of the improvements identified and their corresponding category (i.e., near, medium and long-term).

Near-Term Improvements

Near-term improvements were those projects that had secured funding sources and were underway in one way or another (design, construction, etc).

- Leisure Town Road Park and Ride
- Bella Vista Road Park and Ride
- Fairfield Transportation Center – Phase 2
- Red Top Road Park and Ride
- Leisure Town Road Interchange Improvement
- Widening EB/WB I-80 – I-680 to SR 12 East

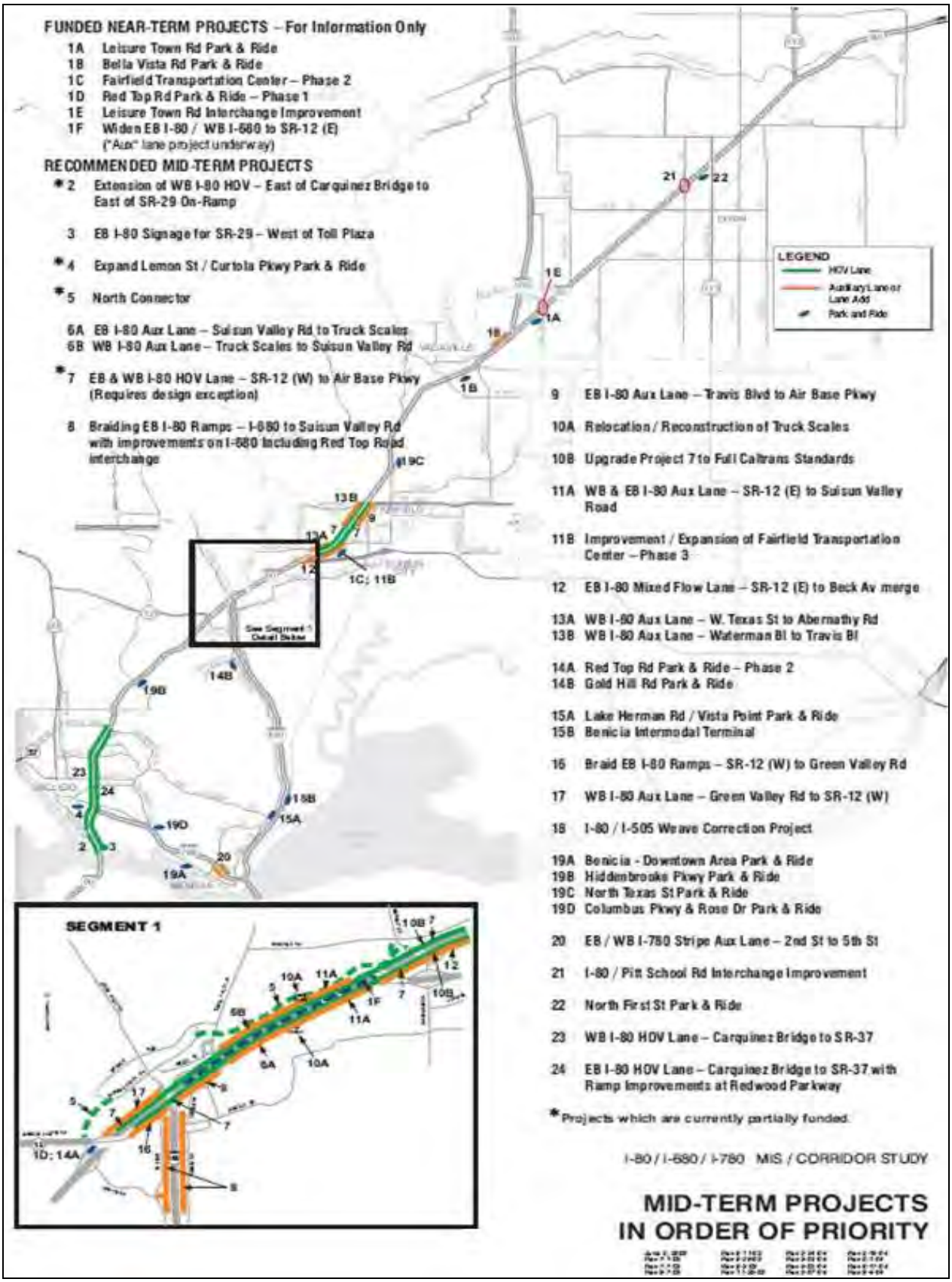


Medium-Term Improvements

- Project 2 – Extend I-80 WB HOV Lane Eastward from SR 29 Merge
- Project 3 – Install EB I-80 Signage for SR 29 – West of Toll Plaza
- Project 4 – Expand Lemon and Curtola Park-and-ride Lot
- Project 5 – North Connector
- Project 6A – EB I-80 Auxiliary Lane – Suisun Valley to Truck Scales
- Project 6B – WB I-80 Auxiliary Lane – Truck Scales to Suisun Valley
- Project 7 – I-80 HOV Lane – SR-12 West to Air Base Parkway

- Project 8 – Braiding EB I-80 Ramps – I-680 to Suisun Valley Road
- Project 9 – I-80 Eastbound Auxiliary Lane – Travis to Air Base Parkway
- Project 10A – Truck Scales Relocation/Reconstruction
- Project 10B – Upgrade Project 7 to Full Caltrans Standards
- Project 11A – EB and WB I-80 Aux Lane – SR-12 E to Suisun Valley
- Project 11B – Expand Fairfield Transportation Center – Phase 3 – With Access Improvements
- Project 12 – EB I-80 Mixed Flow Lane – SR 12 East to Beck Avenue Eastbound On-Ramp
- Project 13A – I-80 Westbound Aux Lane – West Texas to Abernathy
- Project 13B – I-80 Westbound Aux Lane – Waterman to Travis
- Project 14A – Red Top Road Park-and-ride Phase 2
- Project 14B – Gold Hill Road Park-and-Ride
- Project 15A – Lake Herman/Vista Point Park-and-Ride
- Project 15B – Benicia Intermodal Terminal
- Project 16 – Braid EB Ramps – SR-12 West to Green Valley Road
- Project 17 – Westbound I-80 Aux Lane – Green Valley Road to SR-12 West
- Project 18 – I-80/I-505 Weave Correction Project
- Project 19A – Benicia Downtown Area Park-and-Ride
- Project 19B – Hiddenbrooke Parkway Park-and-Ride
- Project 19C – North Texas Park-and-Ride
- Project 19D – Columbus and Rose Park-and-Ride
- Project 20 – EB/WB Aux Lane – I-780 East 2nd Street to East 5th Street
- Project 21 – I-80/Pitt School Road Interchange Improvement
- Project 22 – North First Street Park-and-Ride
- Projects 23 and 24 – WB/EB I-80 HOV Lane – SR 37 to Carquinez Bridge

There were altogether thirty-three mid-term projects, with twelve in Segment 1, five in Segment 2, three in Segment 3, three in Segment 4, one in Segment 5, seven in Segment 6 and two in Segment 7. The figure below, taken from the study illustrates the improvements and their priorities.


FUNDED NEAR-TERM PROJECTS – For Information Only
1A Leisure Town Rd Park & Ride
1B Bella Vista Rd Park & Ride
1C Fairfield Transportation Center – Phase 2
1D Red Top Rd Park & Ride – Phase 1
1E Leisure Town Rd Interchange Improvement
1F Widen EB I-80 / WB I-680 to SR-12 (E) ("Aux" lane project underway)
RECOMMENDED MID-TERM PROJECTS
*2 Extension of WB I-80 HOV – East of Carquinez Bridge to East of SR-29 On-Ramp
3 EB I-80 Signage for SR-29 – West of Toll Plaza
*4 Expand Lemon St / Curtola Pkwy Park & Ride
*5 North Connector
6A EB I-80 Aux Lane – Suisun Valley Rd to Truck Scales
6B WB I-80 Aux Lane – Truck Scales to Suisun Valley Rd
*7 EB & WB I-80 HOV Lane – SR-12 (W) to Air Base Pkwy (Requires design exception)
8 Braiding EB I-80 Ramps – I-680 to Suisun Valley Rd with improvements on I-680 including Red Top Road interchange
9 EB I-80 Aux Lane – Travis Blvd to Air Base Pkwy
10A Relocation / Reconstruction of Truck Scales
10B Upgrade Project 7 to Full Caltrans Standards
11A WB & EB I-80 Aux Lane – SR-12 (E) to Suisun Valley Road
11B Improvement / Expansion of Fairfield Transportation Center – Phase 3
12 EB I-80 Mixed Flow Lane – SR-12 (E) to Beck Av merge
13A WB I-80 Aux Lane – W. Texas St to Abernathy Rd
13B WB I-80 Aux Lane – Waterman Bl to Travis Bl
14A Red Top Rd Park & Ride – Phase 2
14B Gold Hill Rd Park & Ride
15A Lake Herman Rd / Vista Point Park & Ride
15B Benicia Intermodal Terminal
16 Braid EB I-80 Ramps – SR-12 (W) to Green Valley Rd
17 WB I-80 Aux Lane – Green Valley Rd to SR-12 (W)
18 I-80 / I-505 Weave Correction Project
19A Benicia - Downtown Area Park & Ride
19B Hiddenbrooke Pkwy Park & Ride
19C North Texas St Park & Ride
19D Columbus Pkwy & Rose Dr Park & Ride
20 EB / WB I-780 Stripe Aux Lane – 2nd St to 5th St
21 I-80 / Pitt School Rd Interchange Improvement
22 North First St Park & Ride
23 WB I-80 HOV Lane – Carquinez Bridge to SR-37
24 EB I-80 HOV Lane – Carquinez Bridge to SR-37 with Ramp Improvements at Redwood Parkway
*Projects which are currently partially funded.
LEGEND
HOV Lane
Auxiliary Lane or Lane Add
Park and Ride
SEGMENT 1
I-80 / I-680 / I-780 MIS / CORRIDOR STUDY
MID-TERM PROJECTS IN ORDER OF PRIORITY

Long-Term Improvements

The list of long-term improvements were as follows:

- I-80 WB/EB HOV Lane, Air Base Pkwy to I-505
- I-80 EB Mixed Flow Lane - SR 12 (E) to Air Base Parkway
- I-80 EB Mixed Flow Lane - SR 12 (E) to Air Base Parkway (Full Standards)
- I-80 / I-780 Interchange Improvements
- I-780 EB / WB Auxiliary Lane - Military Way to Columbus Parkway
- Turner Pkwy Extension over I-80 to Fairgrounds Dr with Park & Ride and HOV Connectors
- Vacaville Intermodal Transportation Center
- EB I-80 Aux Lane - Redwood Pkwy toSR-37 with 2 lane off-ramp
- EB I-80 Aux Lane - Tennessee St to Redwood Pkwy
- I-80 EB / WB Mixed-Flow Lane - SR 12 (E) to I-680
- I-80 WB Mixed Flow Lane - Air Base Pkwy to SR-12 (E)
- I-80 Widening - Meridian Rd to Kidwell Rd
- WB I-80 Aux Lane -North Texas St to Waterman Blvd
- EB I-80 Aux Lane -Air Base Pkwy to North Texas St
- EB I-80 Aux Lane Cherry Glen Rd to Alamo Dr
- WB I-80 Aux Lane Merchant St to Cherry Glen Rd
- Braid I-80 WB Ramps Suisun Valley to SR 12 (W)
- I-80 / Curtola Pkwy HOV Connector
- EB I-80 Aux Lane - I-780 to Georgia St
- WB I-80 Aux Lane - Georgia St to I-780
- WB I-80 Aux Lane - Redwood St to Tennessee St
- I-80 EB Auxiliary Lane North Texas Street to Lagoon Valley Road
- SR-113 / I-80 Interchange Improvement
- I-80 EB Auxiliary Lane Alamo Drive to Davis Street
- I-80 EB Auxiliary Lane Davis Street to Peabody Road
- I-80 EB Auxiliary Lane Peabody Road to Alison Drive
- I-80 WB Auxiliary Lane Monte Vista Avenue to Mason Street
- I-80 WB Auxiliary Lane Mason Street to Alamo Drive
- Ramp Improvement through Vallejo (SR-29 to Redwood Rd)
- West A Street Park and Ride
- I-680 NB / SB NOV Lane - Benicia Bridge to I-80
- Walters Road Park and Ride
- I-80 / SR-37 / Columbus Pkwy Interchange Improvement

A summary of the next steps in the study were as follows:

- When the new Solano County travel demand model is complete, the STA should revisit the potential widening of I-80 from Meridian Road to Pedrick Road in Segment 7.
- Conduct a future study of the SACOG gateway on the eastern end of Segment 7. This study should be undertaken when SACOG reaches a decision on the widening of I-80 to the east of Segment 7 and the addition of an HOV lane on the causeway.

- The STA should revisit the prioritization of all mid and long-term projects with the completion of the new travel demand model. This review should be conducted at a cursory level to assure that the recommended priorities remain valid.
- Prepare an ultimate improvement plan for Segment 2 through Vallejo. This plan should integrate economic development planning with planning for freeway improvements.
- Conduct a study of the potential need for and benefit of a future (2040) truck lane on I-80 (particularly through Segments 1 and 6) similar to the current proposal for I-710 in Los Angeles to serve the Los Angeles/Long Beach Port.
- Prepare a Traffic Management Plan for the I-80 corridor. As local interchanges are upgraded, install provisions for ramp metering. Establish prioritization of ramp metering by segment by direction. Design freeway management system components into all major mainline projects.
- Conduct Project Study Reports, preliminary engineering and environmental clearance for the mid-term projects, to prepare for design as funding becomes available.
- As land use patterns, travel demands and the tools to evaluate them evolve, update this corridor study periodically. It is recommended that this study be updated every five years.
- Work with Caltrans and Contra Costa County to finalize a long-range plan for HOV facilities across the Carquinez (I-80) and Benicia Bridges (I-680), linking the two counties.
- Work with Caltrans and Yolo and Sacramento Counties to develop a long-range plan for HOV facilities linking the three counties at the Yolo causeway.

Summary

The Solano Highways Operations Study is an outcome of the I-80/680/780 MIS under Phase 2. This document provides the most comprehensive set of Solano County freeway corridor improvements. However, the most recent studies along the I-80 and I-680 corridors will be the Freeway Performance Initiative (FPI) and the operational improvements identified in those studies were used as the set of improvements for the Solano Highways Operations Study. The discussion of the FPI reports provides additional detail on the set of recommended operational improvements.

For the I-780 corridor, a new traffic operations analysis was conducted and takes into account the near, medium and long term projects identified in the I-80/680/780 MIS.

2.1.2.4 Caltrans Traffic Operations System (TOS) Implementation Plan (2002)

This report focused on the existing and future Traffic Operations System (TOS) elements in the nine county San Francisco Bay Area, and how this system may be modified, operated and maintained. These TOS elements could be all classified under ITS. The goal of the Plan was to help ensure consistency in the deployment of the TOS, adequate planning at every stage of the project, and commit project partners to use state and federal funds as efficiently and as effectively as possible.

Some of the ITS concepts and technologies discussed in the report include:

- Vehicle Detection System
- Ramp Metering System
- CCTV System
- Changeable Message Sign (CMS)
- Highway Advisory Radio (HAR)
- Security Cameras
- Communications System
- Transportation Management Center
- Software
- Traffic Signal Controllers

System Components and Functions

The study reports that the TOS will perform the following five functions:

Traffic Control

- Traffic Surveillance
- Traffic Flow Optimization
- Device Control
- Information Sharing with Other Systems

Incident Management

- Incident Identification
- Response Action Formulation
- Response Implementation
- Hazardous Condition

Pre-Trip Information

- Current Situation Information
- Trip Planning Service
- Available Services Information
- User Access

En-Route Driver Information

- Driver Advisory

Archived Data

- Historical Data Archival
- Data Control
- Data Import and Verification
- Data Warehouse Distribution
- User Interface

These functions form the basis for the utilization of the TOS by Caltrans and other systems as they are integrated with the TOS.

Near and Long-Term Projects

The study identified projects on freeway segments within Solano County as part of the overall TOS buildout. These included:

- Segment 22: I-780 between I-80 and I-680, and I-80 between I-780 and the Carquinez Bridge
- Segment 29: I-80 between I-780 and Highway 12 and I-680 between I-80 and I-780

For these segments, the ITS elements were to be installed include a fiber optic network, CCTV cameras, Changeable Message Signs, Detection, and Ramp Meters. The study was not explicit as to the exact locations of the new field devices.

Summary

This study identifies the types of ITS elements and strategies that are planned for deployment along the three freeway corridors. It will be used as an input to the Corridor-Level ITS Architecture including a consideration for the approximate costs and quantities of elements that had been previously considered by Caltrans on the freeway system throughout the Bay Area.

2.1.2.5 I-80 Cordelia Truck Scales Relocation Study

This report recommended that the Cordelia Truck Scales be relocated according to revised Option 1, which places the relocated scales within the I-80/I-680/SR12 interchange and grade separates the truck ingress/egress traffic from the freeway traffic movements. The idea is to use braided truck ramps so that the truck traffic is taken off the freeway and merged back on with little or no impact vehicular traffic on the ramps and the freeway.

The project is currently undergoing the environmental document process with the final design for the eastbound scales relocation to be prepared concurrently with the environmental documentation.

Summary

The project is referenced in several other studies and would provide improved operations with truck and vehicular traffic. The new braided truck ramps and the relocated scales are considered in the set of improvements under this Solano Highways Operations Study. These improvements were included in the I-80 Freeway Performance Initiative.

2.1.2.6 Bay Area Regional ITS Architecture

The Bay Area ITS Architecture is the regional ITS plan for the San Francisco Bay Area. Its purpose is to facilitate ITS planning and to aid in ITS project development and procurement. The ITS Architecture represents the installation and operating technologies over a ten-year horizon in the transportation system environment across jurisdictions in the Bay Area. It provides the framework used to identify ITS deployment priorities, coordinate projects, and understand agency roles and

responsibilities associated with ITS. The Architecture now includes security and emergency operations components and the goals are tied directly to the Regional Transportation Plan.

Study Purpose

The overall purpose of the Architecture is to establish how the projects interact. The technical detail provides information such as what standards and interfaces can be used for systems integration, and to show which other projects and agency systems might be connected in the future.

There are nearly 300 projects listed by name in the Architecture. However, the emphasis is placed more on the large-scale, regional and sub-regional projects that most require and promote connectivity and coordination. For example, 511 is so mature in its development that it is actually represented by four different projects in the Regional ITS Architecture. The major regional/sub-regional projects emphasized in the Architecture include:

- Smart Corridors - SF*go*, SV-ITS, East Bay Smart Corridors, I-680, I-580, I-880
- 511 - 511 Traffic Information, 511 Real Time Transit Information, 511Transit Information, 511 Rideshare/Bicycle Information
- Center-to-Center Communications
- Translink®
- HOT Lanes

With the Bay Area ITS Architecture in place, there will be future updates to the document. Federal regulations (as documented in the Federal Register) mandate that the region "…develop and implement procedures and responsibilities for maintaining [the regional ITS architecture]." The plan for keeping up the Bay Area ITS Architecture into the future includes two primary components:

- A Maintenance Committee, consisting of representatives from each geographic and modal subset of the region, will continue to advise MTC on the ongoing upkeep of the document. The Committee will meet quarterly (as needed) to review and recommend major and minor changes as suggested by project sponsors in the area.

- The Maintenance Committee will advise MTC on issues that impact the architecture especially in areas of near-term (next 5 years) technology growth or major shifts in project development in the region.

Summary

This Regional Architecture will form the basis for the development of the Corridor-Level ITS Architecture. The ITS elements and strategies developed under the Corridor-Level ITS Architecture need to be consistent with this Regional Architecture including the standards, sets of services, and other related projects within and on adjacent counties and corridors.

2.1.2.7 California Statewide ITS Architecture

Given that that a number of areas in California have already developed ITS architectures for their regions, including the Bay Area and Sacramento, there is a need to address the potential for interregional coordination and to comprehensively address state-level needs. The focus of the California ITS Architecture and System Plan was to build upon the existing regional efforts. The plan identifies common transportation challenges that multiple regions are seeking to address with the same or similar solutions. The common threads among the regions will help determine where integration and coordination may add value to travelers across the state.

The California ITS Architecture and System Plan utilized existing and developing regional ITS plans and architectures from all over the State as inputs to develop the framework and baseline. Another way that the statewide architecture relates to the regional architectures is the reciprocal relationship. As regional architectures are updated in the future, the statewide architecture and plan can provide a starting point and framework for updates that emphasize interregional connectivity.

Summary

From the standpoint of the Solano Highways Operations Study, the Statewide ITS Architecture provides a framework for Interregional ITS planning. This framework can support the development of projects that are identified under the Regional ITS Architecture.

2.1.2.8 MTC Regional Transportation Plan (T2030 and T2035)

Transportation 2030 Plan

The vision of the T-2030 Plan proposed three broad approaches/strategies to enhance mobility and improve access to schools, jobs, medical services and other vital destinations. These three strategies were: adequate maintenance, system efficiency and strategic expansion. In the vision, specific elements including Intelligent Transportation Systems, transit consolidation, and HOT lanes were identified as initiatives to improving the overall system's efficiency and producing additional revenue.

System Efficiency

The T-2030 Plan, or the Regional Transportation Plan, outlined the projects in the region that were necessary to meet the visions and goals of the Plan. It was acknowledged in the 2030 Plan that maintaining what was already built in the transportation system was of vital importance for continued urban mobility. Specific strategies including transit consolidation and use of ITS were identified as elements that need more consideration in the transportation system.

Some of the projects listed in the T-2030 Plan within Solano County and relevant to the I-80, I-680 and I-780 Corridors were as follows:

- Route 12 from Sacramento River to I-80 operational and safety improvements as identified in Route 12 Major Investment Study;
  Widen Nut Tree overcrossing from 2 lanes to 4 lanes (includes left-turn lane and ramp improvements);

- I-80/North Texas Street interchange improvements (includes relocation of North Texas Street, new connection between Manuel Campos Parkway and existing bridge, new eastbound on- and off-ramps and new bridge);
- Route 12 westbound (Red Top Road) truck lane;
- I-80/I-680/Route 12 interchange improvements (Phase 1); includes 2-lane connectors between I-80 and I-680 and a fifth lane in each direction on I-80 between I-680 and Route 12;
- I-80/I-680/Route 12 interchange improvements (Phase 2); widen I-80 from Route 12 to Air Base Parkway for HOV lanes (includes a braided ramp from I-680 to Suisun Valley Road and improvements to Red Top Road;
- I-80/I-680/Route 12 interchange improvements (Phase 3); including partial relocation/reconstruction of Cordelia truck weigh station, ramp improvements and auxiliary lanes (as identified in I-80/I-680/I-780 Corridor Study)
- Install a second span along existing Green Valley Bridge to facilitate 4 lanes of travel each way and an acceleration/deceleration lane in each direction
- Match for improvements to local interchanges and arterials
- Construct parallel corridor north of I-80 from Red Top Road to Abernathy Road (the western section extends from the railroad crossing on Red Top Road to Business Center Drive)
- I-80/I-680/I-780 corridor mid- and long-term capacity and operation improvements except transit hubs and park-and-ride lots (as identified in I-80/I-680/I-780 Corridor Study)
- Widen I-80 from 6 lanes to 8 lanes from west of Meridian Road to west of Kidwell Road

Taken from the Comprehensive Transportation Plan (CTP) 2004, the MTC defines uncommitted, discretionary funding that is available for new projects and programs as "Financially Constrained Element" funds. The Financially Constrained Element funds consist of federal discretionary and flexible funds, certain state funds allocated through the State Transportation Improvement Program (STIP) and a small amount in regional toll funds for transit expansion projects. Approximately $9 billion in funds are available to all of the Bay Area counties in the T-2030. Solano County's share of these new Financially Constrained Element funds is estimated at about $422 million The T-2030 assumes that the following projects will receive the highest level of new Financially Constrained Element funds for arterial, highway & freeway projects in Solano County over the next 25 years.

- 1. I-80/I-680/SR12 Interchange - $159.8 M
- 2. Jepson Parkway - $43.0 M
- 3. SR 12 Widening from I-80 to SR29/ Jameson Canyon - $45 M
- 4. SR 12 Safety Projects (I-80 to Sacramento River) - $6.6 M
- 5. I-80/680/780 Corridor Improvements (Mid-term) – $88.4 M
- 6. Road Maintenance (all local roads – non MTS) - $41.0 M
- 7. Local Interchange improvements - $2.0 M
- 8. SR 12 Capacity Improvements (I-80 to Sac. River) - $3.4 M
- 9. Transportation Safety Improvements - $3.0 M

Transportation 2035 Vision Statement

Change in Motion

Transportation 2035 *is* change in motion — guided by the Three Es of economy, environment and equity, along with a set of ambitious goals and performance objectives, that will transform not

only the way we invest in our transportation but the very way the Bay Area travels. The plan sets forth a bold vision and takes us on a journey to:

- Where mobility and accessibility is ensured for all Bay Area residents and visitors, regardless of race, age, income or disability; and
- Where our bicycle and pedestrian facilities, public transit systems, local streets and roads, and highways are all safe and well-maintained and take us when and where we need to go; and
- Where an integrated market-based pricing system for the region's carpool lanes (via a Regional High-Occupancy Toll (HOT) Lane Network), bridges, and roadways helps us not only to manage the demand on our mature transportation system but also to pay for its improvements; and
- Where our lively and diverse metropolitan region is transformed by a growth pattern that creates complete communities with ready, safe and close access to jobs, shopping, and services that are connected by reliable and cost-effective transit services; and
- Where technology advances move out of the lab and onto the street, including clean fuels and vehicles, sophisticated traffic operations systems to manage traffic flow and reduce delay and congestion on our roadways, advanced and accessible traveler information that allows us to make informed travel choices, and transit operational strategies that synchronize fare structures, schedules, and routes to speed travel to our destinations; and
- Where we have a viable choice to leave our autos at home and take advantage of a seamless network of accessible pedestrian and bicycle paths that connect to nearby bus, rail and ferry services that can carry us to work, school, shopping, services, or recreation; and
- Where we lead and mobilize a partnership of regional and local agencies, businesses, and stakeholders to take effective action to protect our climate and serve as a model for national and international action; and
- Where our transportation investments and travel behaviors are driven by the need to reduce our impact on the earth's natural habitats; and
- Where all Bay Area residents enjoy a higher quality of life.

Summary

The T-2035 Plan was adopted by MTC in April 2009. The projects listed in this adopted Plan include the Freeway Traffic Operations System (TOS) buildout, eastbound and westbound auxiliary lanes on I-80 between I-680 and Air Base Parkway, improvements to the I-80/680/SR 12 interchange, and a new mixed flow lane between SR 12 East and Air Base Parkway.

The vision statement of the T-2035 Plan incorporates many goals and objectives that are consistent with the T-2030 Plan including the maintaining the transportation infrastructure, use of advanced technologies to reduce congestion, implementation of HOT lanes, and developing communities with access to transit services.

2.1.2.9 Solano Comprehensive Transportation Plan (CTP) 2005

The Comprehensive Transportation Plan (CTP) for Solano County identifies, plans, and prioritizes the transportation needs of Solano County through the year 2030. The Solano Transportation Authority, as the Transportation Planning and Congestion Management Agency for Solano County, developed

the CTP 2030 in collaboration with its many transportation partners and the public. The vision of the CTP 2030 involves developing a balanced transportation system that addresses the following needs:

- Preserve and enhance quality of life
- Serve all members of the community
- Maintain existing facilities and services
- Enhance regional and local mobility
- Expand travel choices
- Link transportation and land use planning and facilities
- Improve accessibility
- Enhance safety
- Support economic development

The CTP 2030 is an update of the CTP 2025 and earlier transportation plans. This plan identifies overall policies as well as specific policies and projects for three key plan elements:

1. Arterials, Highways, and Freeways
2. Transit
3. Alternative Modes

For the Arterials, Highways, and Freeways Element of the CTP, which is the relevant element for the Solano Highways Operations Study, the following seven objectives were defined:

- Objective A – Preserve the System
- Objective B – Serve Highway Needs
- Objective C – Add HOV Lanes
- Objective D – Enhance Regional and Local Interchanges
- Objective E – Develop a Traffic Management System
- Objective F – Enhance Travel Forecasting Tools
- Objective G – Preserve Right-of-Way

Objective A – Preserve The System
Preserve the physical and operational condition of existing roadway facilities as a means of protecting past transportation investments and maintaining an effective system.

Objective B - Serve Highway Needs
Develop a plan and implementation program for the highway system that serves current and future needs.

Objective C - Add HOV Lanes
Develop a plan and implementation program for a High Occupancy Vehicle (HOV) system that serves future transit, carpool and vanpool users.

Objective D - Enhance Regional and Local Interchanges
Develop a plan and implementation program for regional and local interchanges that provide linkages to the roadways of countywide significance.

Objective E – Develop a Traffic Management System

Develop a plan and implementation program for a traffic management system that serves future needs.

Objective F – Enhance Travel Forecasting Tools
Develop the travel forecasting tools to evaluate the effectiveness of future transportation improvement options.

Objective G – Preserve Right-of-Way
Identify right-of-way preservation measures necessary to meet long-term demand.

Summary

The Comprehensive Transportation Plan published in June 2005 forms the basis for all transportation improvements in Solano County. Many of the improvements, objectives and policies identified in the CTP are still important considerations for the Solano Highways Operations Study. Many of the freeway improvements identified in the CTP were taken from the I-80/680/780 MIS medium and long term projects. In addition, other objectives including HOV lanes and traffic system management are even more important objectives that need to be considered further as new policies and implementation plans are developed. This 2005 CTP is currently being updated.

2.1.2.10 I-80/680/780 Transit Corridor Study

This report provided an analysis of existing services and demand, and implementation plans for the County's intercity express bus services and auxiliary facility improvements, such as direct access ramps to center median HOV lanes, park and ride and transit center demand and site planning. The intercity express bus services that are oriented to the I-80, I-680 and I-780 transportation corridors in Solano County comprise a critical element of the County's multimodal transportation services.

Highway Interface Improvements

The planned HOV lanes located in the median section of the freeway I-80 through Vallejo and I-80 from SR-12 West to Air Base Parkway will significantly improve travel speeds for buses during peak commute periods, but the buses will be challenged to safely enter and exit these lanes at several key locations. For reduced travel times, improved safety and improved schedule reliability, a few access improvements were proposed including:

- Direct Access HOV Ramps
- Fairfield Transportation Center Access
- Park and Ride Improvements

Supportive Policies

The study identified policy measures that would complement the intercity express bus service and park-n-ride facilities improvements. These policies included land use policies, marketing strategies and additional highway coordination measures.

Land Use Policies

Intercity express bus services should connect Solano County residents to their job sites (and other destinations) in other counties. Having future office parks and industrial parks located along the intercity bus corridors and strengthening requirements for pedestrian systems would allow intercity buses to better serve job sites in Solano County.

Marketing Strategies

Having increased intercity express bus services along the corridors will increasingly result in Vallejo and FST buses providing complementary services. Regardless of institutional definitions over operating responsibilities, the consumer (rider) would benefit if the I-80/I-680/I-780 transit services were all labeled the same or in a similar manner.

Real-Time Passenger Information System

Implementation of real time passenger information system for the intercity express bus services would help minimize anxiety about bus schedules. Real time information systems advise riders of the actual time buses are scheduled to arrive at the stop based on satellite location technology.

Additional Highway Coordination Measures

Four additional highway coordination measures were recommended including:

- Install ITS changeable message signs at key commute decision points advising motorists if parking spaces are still available at park and ride lots;
- Ensure that future interchange overpass construction reflects more than minimal pedestrian needs and also accommodates bicycles;
- Consider bus traffic signal timing preferences at selected high volume intersections – FTC signals (Fairfield), Davis Street Transit Center signals (Vacaville) and Curtola and Lemon Street signal (Vallejo); and
- Caltrans is understood not to favor continuous shoulder use, but might accept forced turn for buses using shoulders. Any newly constructed shoulders will be to full highway design standards, and short segments might lend themselves to queue jumps for buses. Queue jump shoulder use should be further explored with Caltrans.

Actions

The study recommended ten actions as "next steps" towards implementation of the Plan.

1. Incorporate I-80/I-680/I-780 Transit Corridor Study's Plan into the Update of the Solano Comprehensive Transportation Plan;
2. Seek to develop funding and implementation plans for the first five year projects (with particular attention to right of way protection for park and ride facilities);
3. Develop an annual and multi-year funding agreement MOU for intercity transit services among the transit operators;
4. Fund and conduct a Transit Consolidation Study, which includes bus maintenance and storage yard issues;
5. Seek operating funding through Regional Measure 2 and local transportation measure to implement elements of the Plan;
6. Work with Caltrans and Contra Costa County to provide a continuous eastbound HOV facility on I-680 by eliminating the short gap approaching the Carquinez Bridge;

7. Work with Caltrans to provide a southbound HOV approach to the Benicia Bridge, on I-680 and on the bridge;
8. Coordinate with BART to upgrade the El Cerrito del Norte shelter for Vallejo Transit passengers, including provision of real time passenger information at the shelter;
9. Fund and initiate a transit corridor study for SR-12 (in coordination with Caltrans District 10, District 4, Napa and San Joaquin Counties); and
10. Coordinate bus service with planned HOV lanes on I-80 through Vallejo and I-80 through Fairfield and Vacaville.

Summary

This study recommended several key elements directly related to the Solano Highways Corridors. These included coordination of bus services with the planed HOV lanes on I-80 in the County, the provisions for more HOV lanes for buses to use and providing the direct access to those HOV facilities, and use of advanced technologies such as real-time passenger information for transit users. The transit consolidation study is currently underway. Similar to many of the studies prepared along these corridors, one of the recommendations is to incorporate the findings of the study into the update to the Comprehensive Transportation Plan.

2.1.2.11 SR 12 Major Investment Study (MIS)

Based on the evaluation of alternatives under this study, the following phased improvements were recommended to be carried forward by STA.

- TDM measures including a carpooling program with a park and ride, a local shuttle program and transit service on SR12.
- Safety Improvements including Advance Overhead Flashers at Beck/Pennsylvania, Left Turn Lanes & Acceleration/Deceleration lanes at Lambie/Shiloh with Realignment, Traffic Signal at SR 113/SR 12, Left Turn Lanes and Acceleration/Deceleration lanes at Church Road with Realignment, Advance Flashers at Summerset Road, Acceleration and Deceleration Lanes at Railroad Museum and Acceleration/Deceleration Lanes at Beck Avenue
- Traffic operations improvements including Geometric Improvements at Pennsylvania Avenue, Traffic Signal and Improvements at Lambie/Shiloh and Traffic signal at SR 113/SR 12
- Main-Line widening including Widen to Four-Lanes Rio Vista City Limit to River Road, Widen to Six-Lanes from Interstate 80 to Webster/Jackson, Install Median Barrier and Shoulders from Walters Road to Rio Vista City Limit, Grade Separation at Pennsylvania Avenue, Left Turn Lanes at Lambie/Shiloh, Traffic Signal at Church Road, Rio Vista Bridge

The combination of these four packages were expected to serve long-term traffic projections and resolve the identified safety issues in the SR 12 study corridor.

Summary

This study provided the recommendations for operational improvements along SR 12 which is a collector and feeder to I-80. The recommended improvements that were identified included the

recommendation to widen SR 12 to six lanes starting at I-80 to Webster/Jackson interchange in Fairfield.

2.1.2.12 MTC's HOV Master Plan

The study was completed in 2002 and made recommendations for the HOV Lane system improvements and operational changes in the Bay Area. It included a review of current HOV lane performance, an assessment of HOV lane forecasts (2025) from the latest modeling conducted for the 2001 Regional Transportation Plan (RTP), and developed more current forecasts (2010). This assessment has led to the development of recommendations for how the HOV lane system could be expanded beyond what is already included in the 2001 RTP. HOV lane improvements that support further development of MTC's Regional Express Bus Program, and recommendations for expansion of the express bus operations in the region were also developed.

Master Plan Recommendations

In addition to the infrastructure improvements identified in this report, a number of operational changes were considered and recommendations made. They are described in the sections that follow. The recommendations for operational changes were based on analysis of the HOV lane system performance (existing and predicted future) in the peak direction and during the AM peak period.

Hours of Operation

The current implementation of the hours of operation of HOV lanes are tied to the travel patterns in each individual corridor. As a result, the hours of operation are not the same throughout the region, but instead vary from corridor to corridor. Moreover, HOV restrictions are only during the peak commute periods and not 24 hours per day as in many other metropolitan areas. In two instances, Marin US 101 and Contra Costa SR 4, HOV lanes operate in the peak direction only. The study noted that at present this peak direction approach only appears to work well. It provides the HOV lanes for use during congested periods of the day and provides supplemental capacity in the off-peak if it is needed. This helps to maintain public support and potentially improves the operation of the freeways during some off-peak periods when the mixed-flow lanes might get congested.

The study recommended that as congestion continues to increase in the Bay Area and the length of the peak period expands on the region's freeways, the Bay Area should consider moving toward a consistent region wide set of hours. This should probably correspond to the current maximum spread of 5:00 a.m. to 10:00 a.m. and 3:00 p.m. to 7 p.m. Although congestion may occur outside of these peak periods in some corridors, the effectiveness of HOV lanes in producing a shift in mode to carpooling, vanpooling or transit is primarily an issue for commute trips. There is no evidence that the Bay Area would benefit from 24-hour HOV lane restrictions that are common in Southern California or other parts of the U.S.

Occupancy Requirement

The study concluded that the HOV lane volumes then did indicate that there is no need to consider changing HOV lane occupancy requirements. However, by 2025, most of the corridors are projected to have HOV lane volumes that exceed the HOV lane capacity. Some of the

strategies to that were recommended to ensure the HOV lanes remain relatively congestion free and continue to provide travel time savings, included:

- Improve overall corridor performance – Strategies would include: expanding express bus service, expanding CHP enforcement, adding auxiliary lanes to remove key bottlenecks and expanding use of ramp metering.
- Increase HOV lane vehicle occupancy – No freeway segments currently warrant a change in occupancy requirement. Over the longer-term, increasing the HOV vehicle occupancy requirement would reduce HOV lane volumes and restore travel time savings.
- Increase vehicle occupancy but charge for 2+ carpool use

High Occupancy Toll (HOT) Lanes

The study recommended consideration of HOT lanes as a method of managing HOV lane demand and it noted that previous assessment efforts have indicated that any HOT lane application on most existing Bay Area HOV lanes would almost certainly have to be one that relies on a low level of infrastructure and lane separation. Most existing Bay Area HOV lanes and freeways do not have the lane separation or the median space to implement the limited entry/exit systems that are found in other areas of the country. A low-cost Bay Area wide application on existing HOV lanes could rely on a monthly subscription system that allows use of a prominently displayed color-coded sticker on non-carpool vehicles to determine eligibility.

I-80 in Solano County

The following were recommendations from the study for I-80:

Infrastructure Improvements

- New HOV segment, N Texas St to I-505
- Minor HOV lane express bus stop, Vallejo (Marine World area/SR 37)
- New HOV lane segment, I-680 to Carquinez Bridge
- Freeway-to-Freeway HOV lane connection, I-80/I-680

Operational Improvements

- Support express service by adding service in the Blue Stream
- Support express bus service by identifying locations to implement bus rapid transit improvements on arterial streets that provide access to and from I-80 HOV lanes

I-680 in Solano County

The following were recommendations from the study for I-680:

Infrastructure Improvements

- Minor HOV lane express bus stop, Benicia (Lake Herman Rd) – Priority I
- New HOV segment, I-80 to Benicia Bridge – Priority II
- Freeway-to-Freeway HOV connection, I-80/I-680 – Priority II

Operational Improvements

- Support express service by adding service in the Orange Stream

- Consider temporary use of shoulders for HOV and/or express bus use until permanent HOV

Summary

The recommendations from this HOV Master Plan should be considered as they relate to the Solano Highways Operations Plan. This includes the implementation of a region wide HOV lane set of hours and HOT lanes.

2.1.2.13 Bay Area High Occupancy Toll (HOT) Network Study

The initial study was prepared by MTC and Caltrans and was completed in September 2007. Its purpose was to advance the HOT lanes concept a step to examine the feasibility of creating a complete regional network level of HOT lanes in the Bay Area, as called for in the regional long-range transportation plan, Transportation 2030. The system would be developed by converting the region's extensive existing high occupancy vehicle (HOV) lanes to HOT lanes and closing gaps and extending the HOV/HOT system where possible. A complete regional network, as opposed to a series of individual corridors, has powerful potential to serve travelers, reduce congestion and reduce vehicle emissions at a regional scale. The objectives for the regional HOT network are as follows:

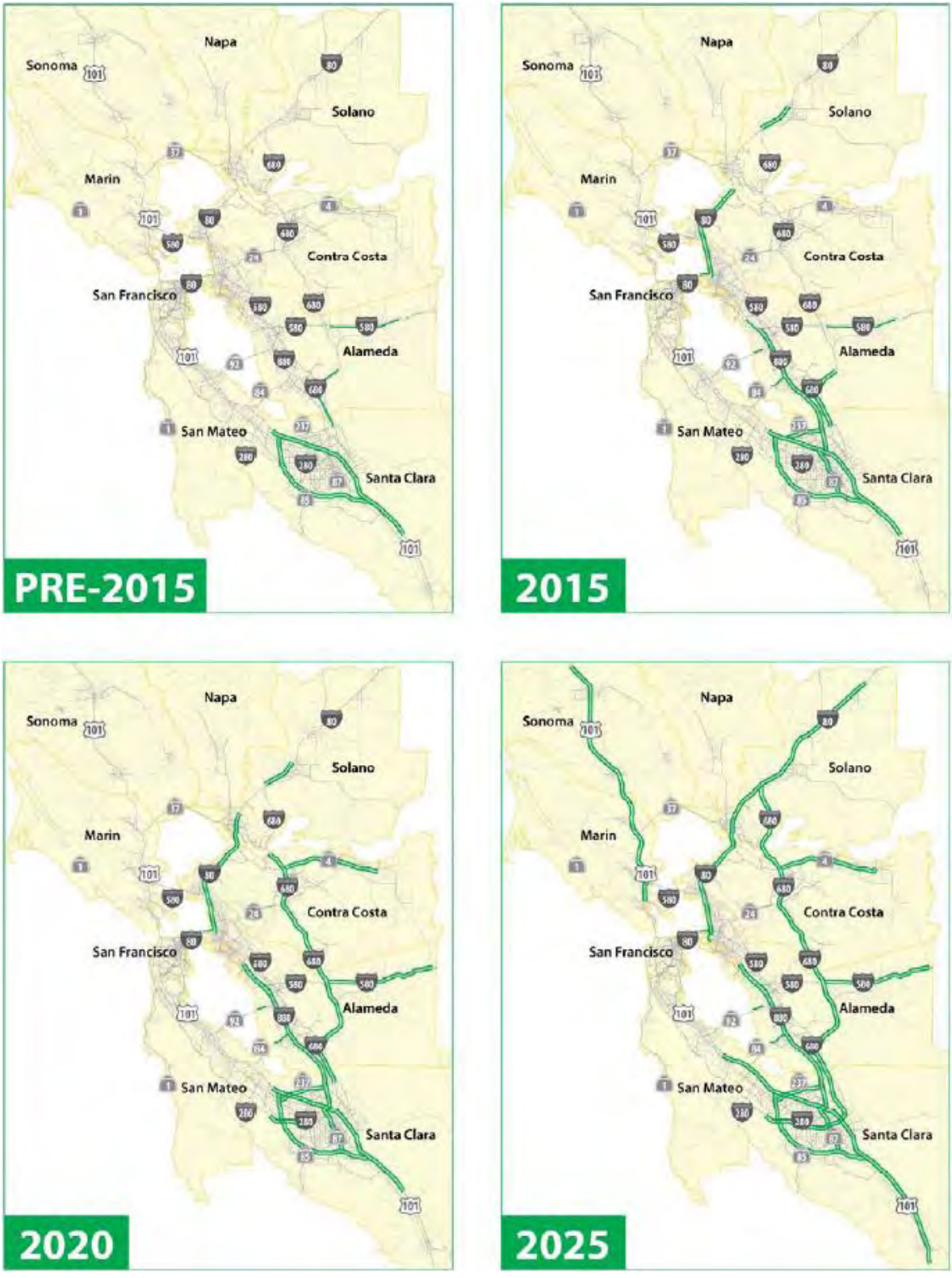
- Ensure efficient operation of an expanded HOV network that provides a safe and reliable travel option for express buses and carpools. HOT lanes can be implemented in a way that ensures priority for buses and carpools today and into the future. A regional network of HOT lanes could provide funding to complete the priority network decades sooner than would be possible using traditional state and federal funding sources.
- Improve the efficiency of the freeway system by reducing person-hours of delay and vehicle-hours of delay.
- Offer congestion insurance. Studies show travelers from all income groups and professions value having a reliable travel option for those times when they most need it.
- Make HOT lanes and their benefits, including improved reliability and reduced travel time, accessible to all impacted travelers.

Four HOT lane corridor demonstration projects are scheduled to open in the Bay Area by 2013 under existing state legislative authority. The first of these will open on I-680 over the Sunol Grade in 2010. The other demonstration corridors include I-580 eastbound through the Tri-Valley, and US 101 and State Route 85 in Santa Clara County. A number of other cities in the US have recently opened HOT lane facilities or plan to do so in the next five years.

This first-order analysis suggests the region's HOV system can incorporate HOT lane functions and continue to offer priority for carpoolers and express buses, while improving overall freeway efficiency. Further, it states that the Bay Area HOT network could be delivered by 2025 and could be self financing over a 30-year period if developed and financed as a regional system rather than a corridor-by-corridor endeavor. However, current state law does not provide a governance framework for a truly regional network. Further discussions with state, regional and local stakeholders are necessary to define a workable governance structure.

Implementation Phases of the Bay Area HOT Network

The study made recommendations on the time frames for the implementation of the various segments of the HOT network throughout the Bay Area. The first figure below illustrates the time frames for the HOT lanes along I-80 and I-680, and the second figure below illustrates that I-80 and I-680 in Solano County are slated to have HOT Lanes as part of the overall Regional HOT network.



In Solano County, the HOT Lanes are recommended in the study to be completed along portions of I-80 by 2015 and along all of I-80 and I-680 by 2025. However, MTC would like to see the implementation of the entire HOT network before 2025.

Next Steps

This initial assessment suggests a Bay Area HOT network can accelerate completion of a priority network for carpools and buses and improve freeway efficiency. Further because a HOT network is self-financing, its development could free close to two billion dollars that would otherwise be needed to complete the region's HOV system. A general roadmap for advancing the HOT network included the following next steps, some of which would need to proceed in parallel.

Refined analysis

The study identified the initial steps for the additional analysis. The first step would consist of a more detailed analysis to refine cost and revenue estimates and review operational concerns. Refining the cost estimates requires a more thorough review of the network's physical design, existing constraints and opportunities for ingress, egress and enforcement locations. Design refinements allow refined demand and revenue forecasts, which in turn permit a more detailed assessment of operations considerations. At each stage, it will be important to reconsider the basic parameters of the phasing and financing plans. Some of the relevant areas requiring further review included:

- Interstate 80. Opportunities for incorporating HOT lanes in the I-80 corridor through Alameda and Contra Costa counties in conjunction with steps to preserve and improve the HOV function and overall traffic flow in the corridor.
- Interface with other planned improvements. This means putting in place procedures so projects under development do not unwittingly preclude the option to provide a HOT lane in the future. It also means considering the potential traffic impacts of HOT lanes in freeway corridor management planning. Integration with other planned improvements could streamline project development and accelerate implementation of the HOT network.

Subsequent, even more detailed analysis would be conducted as part of the formal documents required in the Caltrans project development process (project study reports and project initiation documents). Some of the highlights of the study's discussion items and recommendations are listed below.

Review of equity considerations

As refined design, demand and revenue analyses become available, it will be possible to assess the equity implications of the regional HOT network. This assessment will consider the distribution of benefits and impacts relative to geography and income level. The assessment will also document the benefits and impacts to transit users and carpoolers.

Governance

The region and state need to map out a governance structure for the regional HOT network. The governance structure must provide a means to establish a host of policies governing, design, tolling and operations practices, and revenue allocation, and address potential roles for the private sector. Ultimately, legislative action would be required to enable development of a regional network and, most likely, to transition the current authorized corridor demonstration projects into a regional governance structure.

Public dialog

A certain degree of public dialog and education about HOT lanes has already begun in conjunction with the Alameda and Santa Clara county demonstration projects. This will ramp up over the next year with advancements in project development, the kick off of I-680 HOT lane marketing and education campaign, and the update of the regional long range transportation plan. The region should expand and piggyback on these efforts over time in conjunction with the steps described here to advance the regional network.

Financing

The HOT network financing plan will need to be refined as cost and revenue projections are refined.

Summary

Given that the overall Bay Area HOT Network includes I-80 and I-680 in Solano County, the issue of HOT lanes should be part of the Solano Highways Operations Study. However, given that there are no HOV lanes at present in the County, the implementation of HOT lanes would be a conversion from the future HOV lanes. The implementation process of the I-680 HOT lanes by 2010 should provide much of the lessons learned and directions for any HOT lanes in Solano County. MTC approved the Bay Area High Occupancy Toll (HOT) Network Study update in 2008..

The implementation of HOT Lanes on I-80 beyond Solano County will need regional coordination between Caltrans (Districts 3 and 4), MTC, STA, SACOG, PCTPA (Placer County Transportation Planning Agency). The determination of whether to end the HOT Lanes at the Solano/Yolo County line or extend it eastward into Yolo, Sacramento and Placer Counties may require additional feasibility studies.

2.1.2.14 FHWA's Active Traffic Management: The Next Step in Congestion Management

This document summarized the findings from a scan team of different European systems and how they have implemented what is referred to as "Active Traffic Management." The definition of Active Traffic Management and its application in the US is the ability to dynamically manage recurrent and non recurrent congestion based on prevailing traffic conditions. Focusing on trip reliability, it maximizes the effectiveness and efficiency of the facility. It increases throughput and safety through the use of integrated systems with new technology, including the automation of dynamic deployment to optimize performance quickly and without the delay that occurs when operators must deploy operational strategies manually.

Some of the strategies identified include speed harmonization, temporary shoulder use, junction control, and dynamic signing and rerouting and managed lanes. In addition, the report identified various institutional issues essential to the successful implementation of active traffic management. These include customer education, prioritization of operations in planning, programming, and funding processes, cost effective solutions, public-private partnerships to the extent possible, and consistency of deployments across jurisdictional boundaries.

The primary recommendations from the report included:

- Promote active management to optimize existing infrastructure during recurrent and non-recurrent congestion.
- Emphasize customer education and focus on trip reliability.
- Integrate active management into infrastructure planning and programming processes.
- Make operations a priority in planning, programming, and funding processes.
- Develop tools to support active management investment decisions.
- Consider public-private partnerships and other innovative financing and delivery strategies.
- Provide consistent messages to roadway users.
- Consider pricing as only one component of a total management package.
- Include managed lanes as part of the overall management of congested facilities.

Managed lanes, a component of congestion management, were defined as highway facilities or a set of lanes in which operational strategies are implemented and managed (in real time) in response to changing conditions to preserve unimpeded flow. They are distinguished from traditional forms of lane management strategies in that they are proactively implemented and managed and may involve using more than one operational strategy with the goal of achieving unimpeded flow.

Active Traffic Management Strategies

There were nine strategies that were recommended that will contribute to the United States moving toward comprehensive active traffic management to manage congestion. These strategies were as follows:

- Speed Harmonization
- Temporary Shoulder Use
- Queue Warning
- Dynamic Merge Control
- Construction Site Management
- Truck Restrictions
- Dynamic Rerouting and Traveler Information
- Dynamic Lane Markings
- Automated Enforcement

As noted in the report, while some strategies are already used in regions across the country, it is the combined application of these strategies in a corridor that represents a shift in the way transportation agencies operate freeways. These strategies are designed to be applied to address both recurrent and non-recurrent congestion. The report finally states that although these strategies are described individually, it is the combined, holistic application of the strategies for an entire network or region that will provide the most benefit.

Summary

This study identified several active traffic management strategies that could be considered for implementation along severely congested roadways. The concept of managed lanes was introduced with the strategies identified to manage congestion. Some of these strategies are being considered for I-80 in Contra Costa and Alameda County as part of the I-80 ICM. The

objective of the traffic management strategies is to automate as much as possible the implementation of the strategies in order to reduce the reaction to congestion compared with manual implementation of certain strategies.

One recommendation of the study is that there are a series of traffic management strategies that should be looked at as a group and implemented in conjunction with each other. For example, queue warnings implemented with speed harmonization.

A key recommendation of the study is that a comprehensive set of roadway sensors are needed and the information from these sensors need to be accurate and reliable in order to gain the public's trust and confidence in the system. This is consistent with any type of traveler information and congestion management system that disseminates information in real-time.

For the I-80/680/780 corridors, the concept of managed lanes can be a set of strategies that could be utilize to address future increased congestion. Having the I-80 ICM project move forward with some of these strategies will play a significant role in the feasibility of implementing these strategies in Solano County.

2.1.2.15 WCCTAC/ACCMA Integrated Corridor Mobility Project (I-80 ICM)

The I-80 ICM project goal is to create a uniform, stable, balanced flow throughout the corridor, including the freeway, ramps and the arterial network. Currently, travel speeds and times are widely varied and the system is not well-balanced between arterials and freeways, single-occupancy vehicles and transit. Arterials and freeways must work together as an integrated system, with both road networks of equal importance. Together all of the solutions will create an integrated corridor mobility that is equitable for all users, and will maximize the efficiency of the entire system.

Project Overview

The Interstate 80 (I-80) Integrated Corridor Mobility (ICM) project will focus on improving mobility on the I-80 corridor from the Bay Bridge Toll Plaza to the Carquinez Bridge (see Figure below). This effort is lead by Alameda County Congestion Management Agency (ACCMA) in collaboration with many local and state stakeholders, including Caltrans, Contra Costa Transportation Authority (CCTA), Western Contra Costa Transportation Advisory Committee (WCCTAC), Metropolitan Transportation Commission (MTC), transit agencies and other jurisdictions. This project presents an opportunity to further integrate freeway and arterial networks including field elements, communication, and Advanced Transportation Management and Incident Management Systems. The purpose is to create a balanced, stable traffic flow throughout the corridor with an emphasis on multi-modal, responsive, and equitable solutions.

Corridor Description

The I-80 ICM project is a 20.5 mile corridor running from the Bay Bridge Toll Plaza in Oakland to the Carquinez Bridge in Crockett. The corridor is located within Alameda and Contra Costa County, and includes alternative parallel arterial routes, transit services, and roadways that connect these facilities. The commute periods are directional with morning commute in the

westbound (southbound) direction and evening peak in the eastbound (northbound) direction. There is also considerable weekend traffic congestion along the southern portion of the corridor. The figure below illustrates the project limits.

The Vision statement for the I-80 ICM project is to *enhance the current Transportation Management System by using State of the Practice solutions to build a balanced, responsive and equitable system that will monitor and control traffic and improve the safety and mobility of the users. The solution will create a balanced network for all users with an emphasis on system reliability and efficiency.*

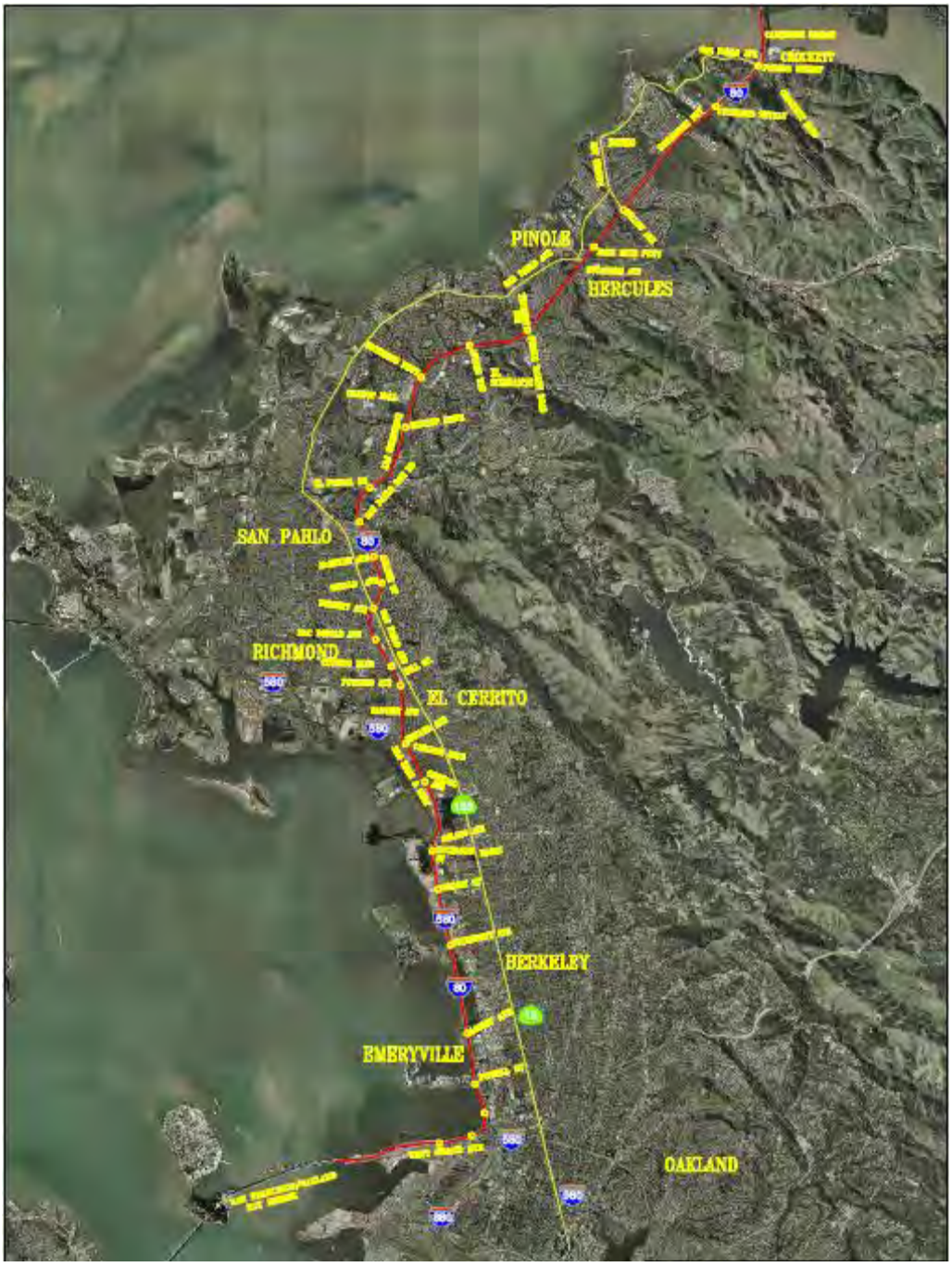
Freeway Management Alternatives

The ICM is evaluating the implementation of traditional ITS elements (e.g., CCTV, CMS, Incident Detection, and Traveler Information) as well as other freeway alternatives that are part of a class of techniques under Active Traffic Management. These alternatives include the following:

- Lane Management
  - Lane Use Signals
  - Dynamic Lane Management
  - Variable Speeds
- Ramp Metering
  - Fixed Time Ramp Metering
  - Dynamic Area-wide Ramp Meters
  - Queue Detectors and Coordinated Signals
  - Ramp Closures
  - Freeway to Freeway Ramp Metering
- Preferential Lane Alternatives or HOT Lanes
- Incident Management

Conclusions and Next Steps

The study concluded that in order to create a balanced and equitable system to address the traffic congestion, most of the strategies discussed in the Concept of Operations must be deployed. The only exception is the Commercial Vehicle Operation strategies, which is recommended to be considered with trucking associations to develop consensus if this measure is to be deployed. The functional requirements and roles and responsibilities are being more defined as the Systems Engineering Management Plan (SEMP) is developed, and this is where each of the concepts will be further defined and evaluated to determine the best extent for implementation of each element.



Summary

For the Solano Highways Operations Study, the concept of managed lanes that are being assessed under the I-80 ICM Project may set the stage for the possible set active traffic management strategies that could be evaluated for the freeway corridors in Solano County. Having the I-80 ICM project move forward with some of these strategies will play a significant role in the feasibility of implementing these strategies in Solano County.

2.1.2.16 SR 113 Major Investment & Corridor Study

The purpose of the State Route (SR) 113 Major Investment and Corridor Study was to identify traffic operations, safety, goods movement, financing, railroad crossings, traffic signals, and other transportation planning issues on this corridor in eastern Solano County. The study focused on the portion of SR 113 between SR 12 and the Solano/Yolo County line in Davis including interchanges with I-80 in Dixon and in Davis.

While the study focused on transportation planning issues within the immediate area, travel patterns were investigated over a broader geographic area to help determine if investments or policies outside of the study limits can address deficiencies and needs within the study area in a cost-effective manner.

The SR 113 corridor is an important transportation facility for the movement of people and goods in eastern Solano County. This mainly rural highway serves a mixture of local, interregional, and tourist traffic. With few north-south highways in the area, SR 113 serves as a critical connector between communities of metropolitan Sacramento, the eastern Bay Area, and the Central Valley.

Prior to this study, there had not been a comprehensive corridor study for SR 113 for over 20 years, and it remained one of the last corridors in northern California with no major investment study. It is anticipated that traffic will increase along SR 113 in conjunction with the anticipated developments in Solano and Yolo Counties. In addition, the anticipated land use and traffic growth in the Central Valley, Sacramento, and San Francisco Bay Area regions will also impact this corridor. When viewed as a whole, certain themes arise across several topics. A subset of these themes that were identified in the study included the following:

- Capacity along the corridor is generally sufficient to handle existing traffic volumes;
- Corridor traffic is regional and local within the City of Dixon and is mainly regional outside of the city limits;
- The rural segment of the corridor is physically constrained by alternating east and west side utility poles and bridge structures;
- Overall collision rates along the corridor are higher than the statewide average;
- High rate of truck collisions occur on the roadway considering a relatively low truck volume percentage; and
- Speeding is the predominant issue cited as the "primary collision factor."

The following are characteristics of the SR 113 Corridor that are expected to remain consistent with 2008 conditions:

- SR 113 will remain a key north-south access route into Dixon;
- SR 113 is expected to continue to significantly influence traffic patterns within the City of Dixon;
- SR 113 is expected to include a mix of long-distance traffic with locally generated commute, noncommute, and truck traffic;
- SR 113 will continue to serve local traffic to access/egress local businesses; and
- SR 113 will continue to serve conflicting regional and local traffic patterns.

Future SR 113 corridor traffic volumes are expected to increase significantly by 2030 in the SR 113 corridor, including 100 percent or more for most of the roadway segments evaluated in the corridor.

Short Term

- Baseline Transportation Management Systems, Traffic Demand Management and Intelligent Transportation Systems

Long Term

- Realignment of SR 113 from Midway to I-80. This option will build the selected realignment of SR 113, north of Midway to I-80, with a two-lane facility with standard shoulders and median.

- Upgrade of the I-80 Interchange based on the SR 113 realignment.

Longer Term

- Widening of SR 113 to a four-lane facility from SR 12 to I-80. This option would widen SR 113 from a two-lane to a four-lane facility from SR 12 to I-80. This would include standard shoulders and median. Timing for a four-lane facility will be dependent on traffic volumes and demand.

- Grade separation of SR 113 and UPRR. This project would build a standard grade separation at SR 113 and UPRR crossing.

- Grade separation of SR 12 and SR 113. This project would build a standard interchange and grade separation at SR 12 and SR 113. A standard interchange, such as a diamond interchange may be adequate for this facility.

- Upgrade I-80/SR 113 (Davis) interchange with direct ramp connectors. This project would build direct freeway to freeway ramp connectors at I-80/SR 113 (Davis).

Summary

The SR 113 MIS was adopted by the STA Board on May 2009. Based on the report, there were several longer-term recommendations for improvements including upgraded interchanges on I-80. The next step in the process would be to conduct further evaluation of the alternatives in the environmental phase. The improvements that affect I-80 are recommended for the long and longer term (>10 years), which would fall closer to the 2030 horizon. Once the recommendations move into the environmental phase, it is then that the improvements along I-80 would be evaluated.

2.1.2.17 I-80 Smarter Growth Study (2009)

This study is a joint planning project between the STA, MTC, SACOG, ABAG and Caltrans. The project produced a final report which included sections that provided following:

- Existing Conditions and Future Forecasts of Demographics, Travel Patterns and Freight Demand;
- Alternative Land Use Scenarios and Growth Patterns;
- Summary of Key Findings and Recommendations.

The specific sections of the final report focused on the following elements:

- A new compilation of interregional demographic projections and smart growth visions for the I-80/Capitol Corridor;
- A new housing and employment market demand analysis for the corridor;
- A comparison of the interregional demographic projections with the growth predicted by the housing market demand study, and the growth that could be accommodated based an analysis of local general plans;
- An analysis of alternative land use scenarios for the I-80/Capitol Corridor that identifies transportation (including goods movement) and air quality impacts;
- An analysis of public policy implications from the study findings and proposed recommendations for resolving inconsistencies and conflicts among overall transportation, demographic and land use assumptions;

Existing demographic and travel forecasts for the I-80/Capitol Corridor were compiled and contrasted. A set of three alternative land use scenarios were developed to model the transportation and air quality implications of different growth scenarios for the corridor. These three land use scenarios were modeled through both the new statewide travel model (also known as the statewide high speed rail model) and the newly upgraded Napa-Solano Travel Model. .

Summary

The study identified six key findings:

3. Smart growth efforts that emphasize a shift in growth away from the edge of each region have potentially significant transportation and air quality benefits.

4. Regional policy-based projections and lower housing forecasts at the edge of the Solano and Yolo regions can damper the increase in travel demand along I-80.

5. Newer policy-based blueprint forecasts for the edge of the two regions are more coincidence than coordination.

6. Interregional commute forecasts are better addressed through the statewide travel model than through regional travel models.

7. The artificial boundary between the Bay Area and Sacramento doesn't hinder just travel and growth forecasting.

8. The lack of interregional coordination has historically put the I-80/Capital Corridor at a competitive disadvantage for securing financing for transportation projects and programs.

Lastly, the study provided five recommendations:

1. Invest in significant upgrades to the California Statewide Travel Model and regional travel models, including land use forecasting models
2. Develop an I-80/Capital Corridor Interregional Corridor Strategic Plan
3. Strengthen State Support for Regional Blueprints and Local Land Use Coordination
4. Explore "Megaregional" Financing Mechanisms for Transportation Projects
5. Develop Better "Megaregional" Coordination and Governance

2.1.2.18 Governor's Strategic Growth Plan/Go California Initiative

This Strategic Growth Plan (SGP) dedicates $107B in transportation funding over the next decade in order to reduce congestion, improve connectivity, improve safety and reduce air pollution.

The SGP relies on a complete systems approach of a variety of strategies: system monitoring and evaluation, maintenance and preservation, smart land use and demand management, and operational improvements. With this foundation, the investments made on system expansion and completion will provide the desired mobility benefits to the extent that these improvements are on top of a well managed and optimized system.

Two propositions were placed on the November 2006 ballot to implement the Strategic Growth Plan and augment existing revenue streams. Proposition 1A protected an existing revenue stream established by the voters in a prior election and Proposition 1B authorized $19.925 billion in bond sales for a variety of outcome-oriented programs. This includes nearly $8B for Mobility Improvement on Highly Congested Travel Corridors including $4.5B for the Corridor Mobility Improvement Account, $1.0B for State Route 99, the main street and backbone of the Central Valley and $2.0B to augment the State Transportation Improvement Program.

Summary

The significance of the Strategic Growth Plan is large in terms of the opportunities for transportation in California. The Proposition 1B elements include the Corridor Mobility Improvement Account (CMIA), the Traffic Light Synchronization Program (TLSP) and the STIP augmentation. The Caltrans requirement for a CSMP on I-80 is a result of the CMIA guidelines.

2.2 Existing ITS Technologies

First, this section will summarize the ITS deployments and technologies recommended for the study area corridors, consisting of a list and description of each ITS technology identified in the studies as well as any other technologies we identified while reviewing the existing reports. Where deployment considerations are documented, we will include this in the summary.

ITS refers to using communication technologies to improve transportation safety, operations, and efficiency. This definition encompasses a broad range of technologies and has created many opportunities for transportation professionals to respond proactively to increasing demand for effective transportation services.

2.2.1 Common ITS Technologies

Some of the common ITS technologies include the following:

- Communications Network
- Closed Circuit Television (CCTV) cameras
- Vehicle Detection Systems.
- Changeable Message Signs (CMS)
- Highway Advisory Radio (HAR)
- Ramp Meters

Each of these ITS technologies are briefly described below as they relate to the freeway corridors in Solano County.

Communications Network

The use of fiber is the preferred communications medium along freeway segments primarily for the transport of video images from CCTV cameras to the Transportation Management Center is Oakland. Fiber provides the greatest data carrying capacity and longest transmission distance in comparison to other non-leased forms of communications media. However, there is limited coverage of the freeway system with a hardwired fiber network in the County. There are short segments on I-80 near I-780 with existing fiber. At locations where there are ITS field devices including CCTV cameras, vehicle detection sensors or highway advisory radios, leased line connections are typically used.

CCTV Cameras

Approximately 500 closed circuit television cameras have been installed on Bay Area freeways. All cameras have remote pan, tilt, and zoom control, and are generally spaced about a mile apart so operators can see all portions of the freeway. The video feeds from CCTV cameras are used by TMC operators to make a visual check of field conditions. The most common application involves checking conditions at a reported incident site. The operator can move the nearest camera to focus on the area of interest to first see if the incident actually exists as reported (incident verification), then check the nature of the incident and the extent of its impacts (incident diagnosis and response planning), and finally, observe the progress of incident response and clearance, and the eventual dissipation of any traffic backup. Cameras are often also used to check the message displayed on a changeable message sign. CCTV cameras follow the NTSC (analog television) standard. More than half of the cameras are still monochrome, but all new cameras are color.

In the County, I-680 is the only freeway segment that has a substantial CCTV coverage. I-80 has CCTV coverage from the Carquinez Bridge to the SR 37. I-780 has little to no CCTV coverage. Because there is sparse coverage of the freeways in the County with fiber, most of the CCTV cameras are communicated with using either a leased ISDN or ADN line.

Changeable Message Signs (CMS)

The use of changeable message signs is a very effective method of providing traveler information immediately to the motorist on the freeway or highway system. It is also an excellent means to inform motorists of where to go to get important information like chain control measures, accidents ahead, road closures and amber alerts. As with all of the ITS field devices, a key to the success of a CMS system is remote communications to the sign itself. Caltrans had standards for the CMS sizes and types, however, a constraint with field deployments is the ability to communicate with the signs using either a leased or non-leased connection. Also, installing the CMS at key locations where it gives the motorists enough time to read the sign and react accordingly such as changing their travel routes in response to an incident ahead.

Vehicle Detection Systems

The ability to count the vehicles on the freeway system is critical to the effective monitoring of the freeway system. Traditionally, a freeway vehicle detection system consisted on pavement loops. Today, a variety of other technologies including microwave, radar, magnetometers and toll tag readers are used on the Bay Area freeways. The ability to collect the traffic volumes provides the required data to determine the operating characteristics of freeway segments and derive the levels of congestion. In addition, with the concept of active traffic management, having accurate and real-time traffic data is imperative for the success of this type of system management.

There are few vehicle detection systems along the freeway corridors in Solano County. However, toll tag readers in Fairfield provide valuable information to the 511 System for travel time information.

Highway Advisory Radio (HAR)

Highway Advisory Radios are used for notifying motorists within a short radius from a low powered radio of traffic conditions. The radios are accompanied with an extinguishable message sign (EMS) which provides a pre-set message of the radio station to tune into for the traffic information. The use of HARs use typically during extreme weather conditions (chain control), or during an incident where the HAR can supplement the information with the use of CMSs (advisories of using alternate routes). The radios are typically turned on with the turning on of the message on the EMS and the radio message can be recorded using a simple telephone connection.

Ramp Meters

The use of ramp meters has been proven to be an effective method of managing the congestion on the

freeway system by limiting the input flow of vehicles entering at freeway on-ramps. Using freeway and on-ramp detection systems, the flow of vehicles entering the freeway is controlled using metering rates. As queues build up on the ramp, queue detectors are used to detect the length of the queue before it reaches the local streets. Should the queue reach queue detectors, the ramp meter system can adjust the metering rates to prevent the queues from spilling onto the local streets. There no ramp meters in operation in Solano County, but it is a policy of Caltrans to install ramp meter equipment at all freeway interchanges.

2.3 Other Advanced ITS Technologies

There are a few ITS technologies that are occasionally categorized as advanced ITS technologies. However, these technologies for the most part take the more common ITS technologies and utilize the information in a more integrated manner. A few of the advanced ITS technologies include the following:

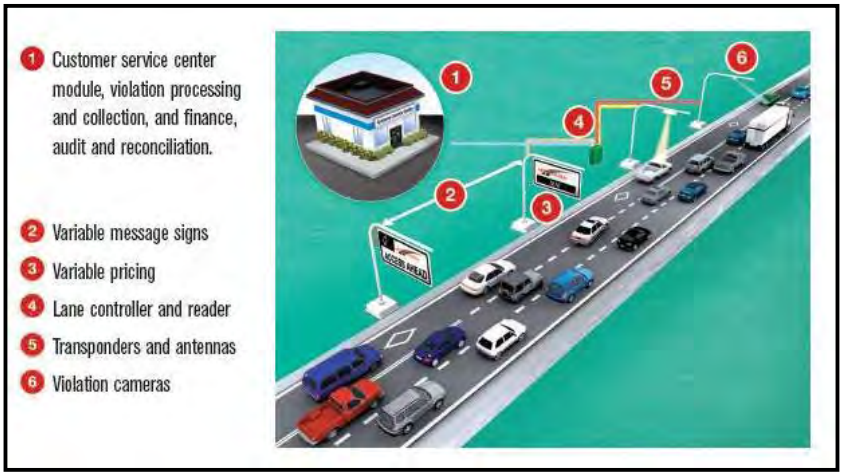
- HOT Lanes
- Adaptive Ramp Metering
- Traveler Information Systems (Trip Planning)
- Real-time Transit Arrival/Departure Information
- Vehicle Infrastructure Integration (VII)
- Active Traffic Management

Each of these ITS technologies are briefly described below.

High Occupancy Toll (HOT) Lanes

HOT lanes are limited-access, highway lanes (normally barrier-separated) that provide free or reduced cost access to qualifying HOVs, and also provide access to other paying vehicles not meeting passenger occupancy requirements of the HOV Lanes. By using price and occupancy restrictions to manage the number of vehicles traveling on them, HOT lanes are intended to maintain volumes consistent with uncongested levels of service even during peak travel periods. Most HOT lane deployments offer potential users the choice of using general-purpose lanes or paying for the use of the HOT lanes.

HOT lanes utilize electronic toll collection and traffic information systems that also make variable, real-time toll pricing of non-HOV vehicles possible. Information on price levels and travel conditions is normally communicated to motorists via variable message signs, providing potential users with the facts they need in order to decide whether or not to utilize the HOT lanes or the parallel general-purpose lanes that may be congested during peak



periods. HOT lanes may be created through new capacity construction or conversion of existing lanes. The conversion of existing HOV lanes to HOT lanes is the most common approach.

Adaptive Ramp Metering

An adaptive ramp metering systems uses vehicle detectors to feed algorithms that forecast when and where congestion will occur. The adaptive system then "adapts" to control upstream ramps, through ramp metering, in order to control congestion on the mainline. The system forecasts the traffic state at predetermined problem points (bottlenecks), and adjusts metering rates based on those forecasts. It treats the freeway network as sections where each section is defined as being between two successive detectors that have reliable data outputs. Some systems are based on traffic density, with the goal of maintaining real-time density below a pre-determined saturation density for each section of freeway.

Traveler Information Systems (Trip Planning)

There are several traveler information systems that enable trip planning along freeway and arterial segments. These systems utilize historical information of travel times and based on the user's travel day and time, the system is able to generate typical travel times. One such system is the Bay Area's 511 System with the Predict-a-Trip feature. The use enters the start and end points, the date and time of travel and the system provides all the freeway segments that service the desired route and the typical travel time for that day and time.

Vehicle Infrastructure Integration (VII) or IntelliDrive

VII is a research program focused on enabling wireless communications among motor vehicles and between motor vehicles and roadside infrastructures. By enabling secure real-time communications with motor vehicles, the goal is to enable services to enhance transportation safety, mobility, and commerce. To achieve the goals of VII, motor vehicles in the United States will need to be equipped with On-Board Equipment (OBE) consisting of one or more communication devices, a positioning device, a processing platform, and application software. For several safety applications, the OBEs will exchange data with Road Side Equipment (RSE), or roadside transceivers. The OBEs will also communicate with other OBEs for vehicle-to-vehicle data exchange.

In the VII Proof of Concept research, vehicle-to-vehicle and vehicle-to-infrastructure communication is enabled by using a dedicated 5.9 GHz bandwidth allocated by the Federal Communications Commission (FCC). This is specifically to achieve vehicle safety goals. In order to meet the secure, low latency, high availability requirements of VII safety systems, a combination of this dedicated spectrum and appropriate communications standards are needed. These standards are being developed based upon the widely-used IEEE 802.11 (Wi-Fi) standards. Other applications may use the same vehicle to roadside link, or may use other communications media.

With VII, an application such as electronic brake warning system will notify drivers of such incidents so that they can take appropriate action. The advancements that VII provides will lead to the development of innovative driver warning and/or automatic vehicle control systems, enabling significant enhancements in vehicle safety.

In the Bay Area, there are several VII Initiatives including a testbed in San Mateo County and a demonstration project that will use VII technologies for tolling applications.

Active Traffic Management

Active Traffic Management as it is being evaluated in the US is defined as the ability to dynamically manage recurrent and non recurrent congestion based on prevailing traffic conditions. The concept is to enable expert systems to optimize the performance of the roadway facility quickly and in a more automated fashion in comparsion to manual implementation of the same optimization strategies. The thought behind the set of strategies is the proactiveness of the system such that there is little delay between the prevailing traffic conditions and the strategies needed to address them. The main strategy is a concept of managed lanes.

Managed lanes is a component of congestion management and is defined as highway facilities or a set of lanes in which operational strategies are implemented and managed (in real time) in response to changing conditions to preserve unimpeded flow. The use of managed lanes is distinguished from traditional forms of lane management strategies in that they are proactively implemented and managed and may involve using more than one operational strategy with the goal of achieving unimpeded flow. Some of the strategies that form the concept of managed lanes include the following:

- Speed Harmonization - Variable Speed Limits
- Dynamic Merge Control
- Dynamic Rerouting and Traveler Information

Each of these is described below.

Speed Harmonization - Variable Speed Limits

Using speed harmonization, the theory is that reducing speeds under congested conditions not only improves overall performance but reduces the likelihood of primary incidents. The strategy is to delay the point at which flow breaks down and stop-and-go conditions occur. An expert traffic management system monitors travel data from the roadway, and once travel speeds and traffic volumes reach a certain threshold set by the system's algorithms, the system automatically begins to reduce speeds incrementally across all lanes along the motorway upstream of where the congestion is heaviest.

Dynamic Merge Control

This strategy aims to limit the flow of the mainline in order to control the downstream queues and congestion. At merges from major interchange ramps, the concept is to dynamically meter or close specific upstream lanes, depending on traffic demand. The thought is that this strategy could easily incorporate ramp metering systems and could offer the potential of delaying the onset of main lane congestion and balancing demands between upstream roadways.

Dynamic Rerouting and Traveler Information

This strategy involves providing users with viable alternative routes in order to reduce the impact of non-recurrent congestion and is strategically implemented with traveler information on message signs.

2.4 Conclusions

This memorandum conducted a literature review of the existing studies that will influence or provide relevant materials and/or information in the development of the Solano Highways Operations Study. While the review covered 18 studies in all, there were a few studies that provide some of the necessary information for the next steps of the Solano Highways Operations Study. These existing studies include the following:

1. MTC's Freeway Performance Initiative (I-80)
2. Caltrans Corridor System Management Plan Guidelines
3. Comprehensive Transportation Plan (2004 + current draft in progress).
4. MTC Regional Transportation Plan (T2030 and T2035)
5. Bay Area Regional ITS Architecture
6. Caltrans Traffic Operations System (TOS) Implementation Plan
7. FHWA's Active Traffic Management: The Next Step in Congestion Management, July 2007
8. WCCTAC/ACCMA Integrated Corridor Mobility Project (I-80 ICM)
9. Bay Area Regional HOT Lane Network Study

The operational improvement recommendations that will be developed for the Solano Highways Operations Study will be based on the Freeway Performance Initiative studies and the policy recommendations will be developed with the Solano Highways Partnership. The objective is to provide the necessary input into the Comprehensive Transportation Plan and the T-2035 Plan.

More immediately, the Corridor-Level ITS Architecture can be prepared given the available information from the existing studies. The brief descriptions of some of the ITS technologies that are available or are under development provided in this memorandum provides the basis for the Corridor-Level ITS Architecture and Implementation Plan and those ITS technologies will be considered as part of that Plan.

As part of the overall project development process, it is recommended that Project Study Reports (PSR) that are prepared for the recommended High Occupancy Vehicle (HOV) lane projects review the feasibility of reversible HOV lanes. This applies to projects that are identified in this Solano Highways Operations Study.

3. OPERATIONAL ANALYSIS

I-80, I-680, and I-780 represent the main freeway corridors in Solano County directly connecting the cities of Benicia, Vallejo, Fairfield, Vacaville, and Dixon to the San Francisco Bay Area and the Sacramento region. These facilities serve a number of users, including, but not limited to: goods movement, commuter traffic, regional through trips, intercity travel and recreational traffic.

This section provides the analysis of the existing and future operations of the freeway corridors in Solano County. It is divided into three sections:

- Performance Degradation Analysis
- Recommended Operational Improvements
- ITS Architecture and Implementation Plan

Each of these sections is described in more detail below.

3.1 Performance Degradation Analysis

With the large amount of traffic traveling through the county, the purpose of this memo is to compile and identify existing and projected operational degradation issues on these facilities as derived from various sources. These sources include the Solano I-80 Corridor Freeway Performance Initiative study, the I-680 North Corridor Freeway Performance Initiative study, and I-780 corridor simulation performed by DKS Associates.

The next section discusses the traffic information compiled in preparing this report. Existing traffic operation conditions within the study area during weekday AM and PM peaks are summarized in Section 3. Also, the causes of recurrent and non-recurrent conditions within each corridor are identified based on the existing data collected. Finally, future traffic operation conditions within the study area during the weekday AM and PM peaks are also discussed in Section 3.

3.1.1 Background Data Compilation

This section discusses the various data and information sources compiled for the purpose of this report. These sources were gathered not only to examine existing conditions but also to analyze future conditions.

The Solano County I-80 and I-680 North Freeway Performance Initiative (FPI) studies served as the primary sources for the assessment presented in this report. The FPI program was funded by the Metropolitan Transportation Commission (MTC) and examined a number of freeway corridors within the Bay Area. The objective of the FPI was to develop freeway strategic plans for each corridor by performing a technical assessment that included identification of major bottlenecks, determination of the causes of traffic congestion, development of potential mitigation strategies, and an assessment of their effectiveness.

The Solano I-80 FPI study encompassed the 44-mile section of I-80 throughout Solano County from the Carquinez Bridge to the Solano/Yolo County line. This study included an assessment of existing (2006/2007), 2015 and 2030 conditions. The existing conditions assessment relied on observed data from numerous sources including the Caltrans HICOMP reports, archived travel speed data from the

MTC 511 Predict-a-Trip system, PeMS, and a limited number of floating vehicle travel time runs. For the 2015 and 2030 analysis, the Solano Transportation Authority (STA) countywide travel demand model was to develop forecasts, and the FREQ12 macroscopic simulation model was used to assess operating conditions. Accident data derived from the TASAS database for the period m September 1, 2003 to August 31, 2006, was used to assess safety concerns within the study corridor. This study was completed in 2008.

The 2030 analysis conducted as part of the I-680 North FPI study results has not yet been approved by the MTC. However, for completeness, these results are cited here to describe forecasted conditions on I-680 for the Year 2030.

The I-680 North FPI study focused on the portion of I-680 located between the I-80 interchange in Solano County and the Alameda/ Contra Costa County line, and included the development of Existing and Future Condition FREQ models for the entire corridor. The I-680 FPI utilized the STA travel demand model to develop forecasts for ramp and mainline locations within Solano County. The latest version of the STA model (Phase 1, using Association of Bay Area Governments (ABAG) 2008 Projections) that was available at the time of analysis was used for this study. As with the I-80 FPI effort, the I-680 FPI study included an assessment of existing (2006/2007), 2015 and 2030 conditions, and the use of FREQ12 to assess operating conditions. TASAS data was also reviewed to assess possible safety concerns. Technical activities for the I-680 North FPI study were completed in early 2008; however, MTC is still in the process of accepting the final deliverables.

It is important to note that the existing conditions assessment conducted as part of the I-680 North FPI study was performed prior to the opening of the new northbound span and toll plaza at the Benicia-Martinez Bridge. Since the opening, congestion has decreased in the area around the bridge and toll plaza. For this report, follow-up observations in this area were performed and used to update the existing conditions assessment presented in the following section.

Because no FPI study was conducted for the I-780 corridor, additional primary analysis was undertaken as part of this effort. This work performed by DKS Associates included the development of AM and PM peak period FREQ models covering I-780 between I-80 and I-680. Existing Condition models were developed using freeway and ramp traffic count data available from the Caltrans Traffic Census and PeMS. The STA countywide travel forecasting model was used to determine traffic growth levels for use in the development of FREQ models reflecting projected 2015 and 2030 conditions. TASAS data was also reviewed to assess possible safety concerns.

3.2 Existing Conditions

The majority of the existing traffic operations condition information reported in this section was taken from the I-80 and I-680 FPI reports. However, this discussion also incorporates new observations for I-680 around the Benicia-Martinez Bridge following the opening of the new northbound span and toll plaza, and new primary analysis of conditions on I-780.

3.2.1 Recurrent Traffic Characteristics

3.2.1.1 I-80 Existing Conditions

From the FPI report prepared for the MTC, segments operating under traffic congestion were defined as operating at or under 35 mph for a period of 15 minutes or more. Four segments of I-80 were identified as operating under these conditions as described below and shown in Exhibit 1.

AM Peak:

- Location 1: Westbound from SR 12 West exit ramp to west of the westbound I-80/southbound I-680 connector. This congestion occurs only in the right lane.

PM Peak:

- Location 2: Eastbound from I-680 on ramp to just west of the SR 12 West on ramp
- Location 3: Eastbound from the Travis Boulevard on ramp to near the Cordelia truck scale
- Location 4: Eastbound from the Yolo Causeway and CR 32-A/32-B interchange to just west of the Mace interchange

During the AM peak, congestion occurs at the SR 12 exit as a result of the high exiting volumes, high percentage of truck traffic (the westbound Cordelia truck scale is located just in advance of the exit ramp) and steep grades on westbound SR 12 after the exit. The queue at this location extends approximately 1 mile. It should be noted that the WB truck climbing lane on SR 12 West which was completed in 2008 eliminated the congestion on I-80.

In the PM peak, congestion at the I-680 on ramp is due to merging traffic from I-680 joining a heavily traveled section of I-80 eastbound. The eastbound queue extends approximately 1.5 miles to just west of the SR 12 West on weekdays, but on Friday afternoons the queue extends 2.5 miles to west of Red Top Road Interchange.

A bottleneck also occurs between the Travis Boulevard on ramp and the Airbase Parkway off ramp due to high demand and ramp merge and diverge movements between these ramps. The queue in this area extends for approximately 4 miles to near the Cordelia truck scale during weekdays.

Finally, PM peak congestion occurs for 4.5 miles from the Yolo Causeway and CR 32-A/32-B interchange to just west of the Mace interchange as well. The congestion occurs when high traffic demand approaching the causeway is combined with traffic entering I-80 from the CR 32-A/32-B interchanges and to a lesser extent at the Mace interchange.

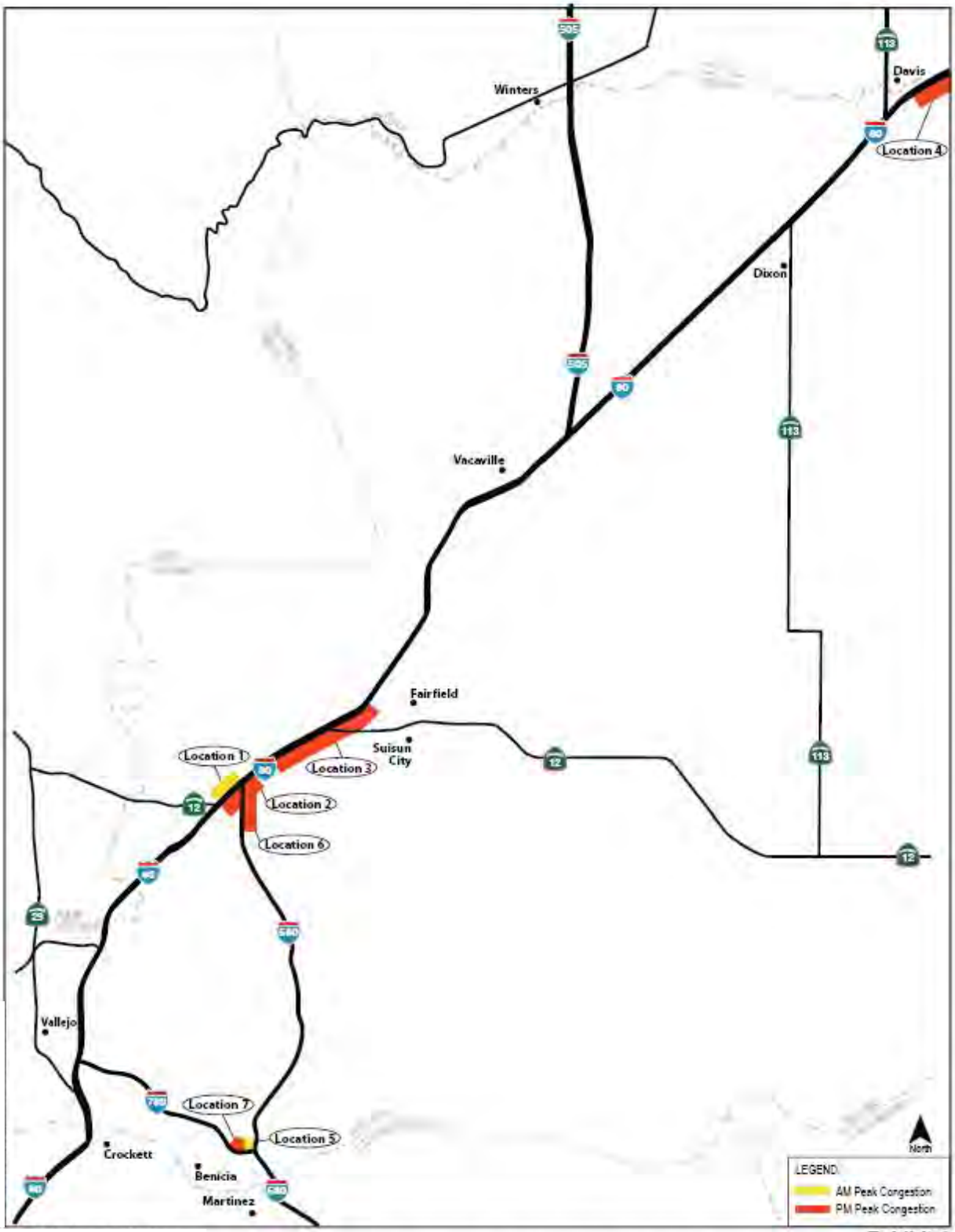


Exhibit 1
Existing Congested Freeway Segments in Solano County
AM and PM Peak

3.2.1.2 I-680 Existing Conditions

The existing conditions assessment conducted as part of the I-680 North FPI study was performed prior to the opening of the new northbound span and toll plaza at the Benicia-Martinez Bridge. Since the opening, congestion has decreased in the area around the bridge and toll plaza. As such, follow-up observations in this area were performed for this report and used to update the existing conditions assessment presented below.

Within Solano County, one segment of I-680 currently experiences congestion during the AM peak period while two were identified during the PM peak period as listed below and shown in Exhibit 1.

AM Peak:

- Location 5: Southbound approaching the north end of the Benicia-Martinez Bridge

PM Peak:

- Location 6: Northbound from the I-80 interchange to south of the Cordelia Road off-ramp
- Location 7: Southbound approaching the north end of the Benicia-Martinez Bridge

During the AM peak, southbound traffic approaching the north end of the Benicia-Martinez Bridge slows to below 40 miles per hour. This is due to the bridge approach geometry including the horizontal curve on the mainline and the limited sight distance for the merge with I-780. It should be noted that this approach will be improved as part of the Benicia-Martinez Bridge project.

Prior to the opening of the new northbound span and toll plaza, congestion also occurred in the northbound direction extending from the toll plaza 0.5 miles north due to the toll plaza operations. Since the opening, the level of congestion associated with the toll plaza has decreased significantly. Also, because the new toll plaza is located at the south end of the bridge, any queuing occurs within Contra Costa County only.

During the PM peak period, congestion occurs in the northbound direction between south of the I-80 interchange and south of the Cordelia Road off ramp is due to the capacity constraints at the merge onto I-80. In the southbound direction, traffic approaching the north end of the Benicia-Martinez Bridge slows to below 40 miles per hour due to the bridge approach geometry including the horizontal curve on the mainline and the limited sight distance for the merge with I-780. It should be noted that this approach will be improved as part of the Benicia-Martinez Bridge project.

Prior to the opening of the new northbound span and toll plaza, congestion also occurred in the northbound direction extending over 4 miles from the toll plaza to the Arthur Road / Pacheco Boulevard interchange due to toll plaza operations. Since the opening, the level of congestion associated with the toll plaza has decreased significantly. Also, because the new toll plaza is located at the south end of the bridge, any queuing occurs within Contra Costa County only.

3.2.1.3 I-780 Existing Conditions

A FREQ model was developed to simulate the existing conditions along I-780 using 2005 or 2006 traffic volumes from Caltrans. In a few cases, the most recent traffic volumes were from 2002 or 2003. Field observations along I-780 were also performed during the Fall of 2008.

The FREQ analysis indicated that there would be no mainline bottlenecks on I-780 queues in either direction for either the AM or PM peak periods. Field observations along I-780 confirmed the FREQ results. However, these observations also revealed slowing at both ends of I-780 as traffic transitions from I-780 to I-80 at the west end and to I-680 at the eastern end. In the westbound direction, high exiting volumes to I-80 combined with high traffic on I-80 result in slowing on the off-ramps that extends back to the right lane on the I-780 mainline. During the AM peak, this occurs primarily at the loop off-ramp to westbound I-80, while during the PM peak the diagonal off-ramp to eastbound I-80 is most affected. At the eastern end of I-780, eastbound traffic heading to southbound I-680 slows due to the bridge approach geometry including the horizontal curve on the mainline and the limited sight distance for the merge with I-680. It should be noted that this approach will be improved as part of the Benicia-Martinez Bridge project.

3.2.2 Non-Recurrent Traffic Characteristics

3.2.2.1 I-80 Existing Accident Characteristics

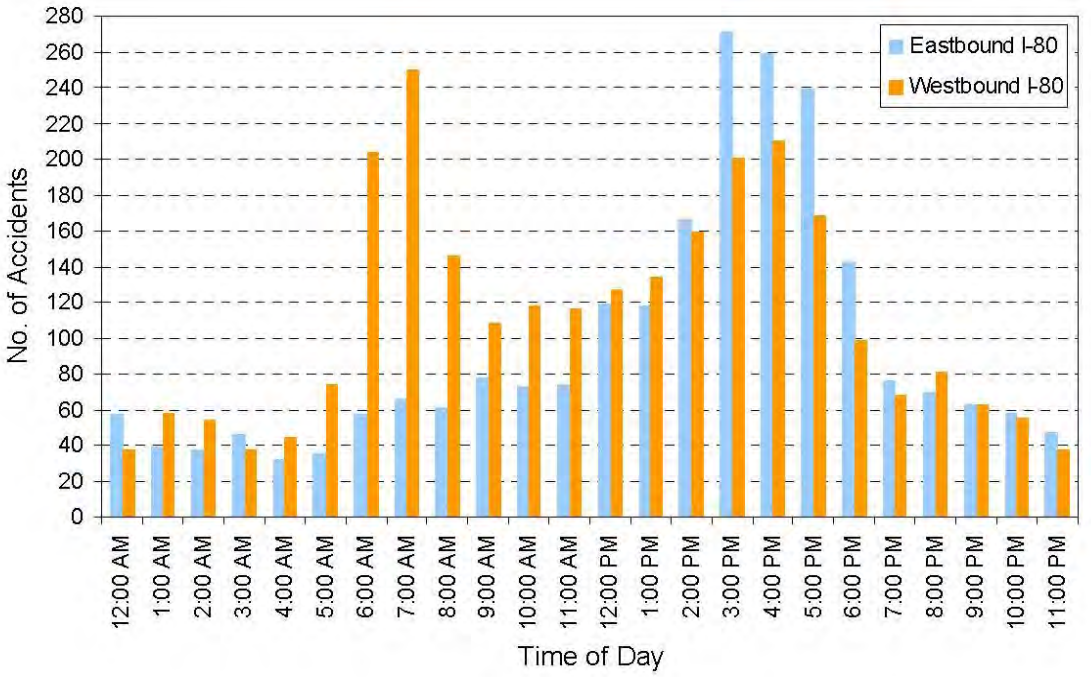
As part of the I-80 FPI, accident data for segments of the I-80 Corridor was reviewed to determine any trends in incident rates and types of accidents. Accident data from September 1, 2003 to August 31, 2006 were collected for six different segments of the I-80 Corridor in each direction. As shown in Exhibit 2, during this three year period there was a total of 4,941 accidents reported along the I-80 corridor in Solano County, an average of 4.5 accidents per day. Of these 1,321 were reported as injury accidents and 36 were reported as fatalities. As shown in Exhibit 2, 11 of the 12 segments have accident rates comparable to the statewide average for similar facilities and area types. However, the 7.8 mile westbound segment of I-80 between Air Base Parkway and Red Top Road has an overall accident rate that is greater than the statewide average for similar facilities.

Exhibit 2: I-80 Accident Summary – September 2003 through August 2006

Direction				Segment Length (Miles)	No. of Accidents			Accident Rates (No. of Accidents per Million Vehicle Miles)					
								Segment Rates			Statewide Average		
					Total	Fat	Inj	Fatal	Fatal + Injury	Total	Fatal	Fatal + Injury	Total
Bridge Toll Plaza	to	Rt 37/I-80 Interchange	EB	5.04	347	1	110	0.002	0.28	0.86	0.007	0.34	1.10
Rt 37/I-80 Interchange	to	American Canyon	EB	2.42	74	1	22	0.006	0.15	0.47	0.007	0.24	0.69
American Canyon	to	Air Base Parkway	EB	11.07	899	4	225	0.004	0.22	0.88	0.006	0.30	0.93
Air Base Parkway	to	Leisure Town	EB	10.68	457	4	134	0.004	0.14	0.48	0.006	0.30	0.93
Leisure Town	to	Kidwell Rd	EB	11.40	385	6	99	0.008	0.14	0.53	0.013	0.32	0.88
Kidwell Rd	to	Richards Blvd	EB	3.46	125	1	38	0.004	0.16	0.52	0.006	0.23	0.67
Richards Blvd	to	Kidwell Rd	WB	3.46	89	2	29	0.008	0.13	0.37	0.006	0.23	0.67
Kidwell Rd	to	Leisure Town	WB	11.40	325	3	84	0.004	0.12	0.44	0.013	0.32	0.88
Leisure Town	to	Air Base Parkway	WB	10.68	657	5	177	0.005	0.19	0.69	0.006	0.30	0.93
Air Base Parkway	to	Red Top Road	WB	7.78	1017	4	251	0.005	0.32	1.27	0.005	0.32	1.02
Red Top Road	to	Columbus Parkway	WB	10.83	202	4	59	0.011	0.17	0.53	0.007	0.25	0.70
Columbus Parkway	to	Carquinez Bridge	WB	5.68	364	1	93	0.002	0.21	0.81	0.007	0.33	1.06
				Total	4941	36	1321						

Accidents on I-80 in Solano County by time of day and direction of travel are shown in Exhibit 3 where it can be seen that the pattern of accidents closely correlates to the pattern of hourly traffic volumes along the corridor. In other words, more accidents occur during those hours when the traffic flows are peaking in the morning and afternoon than during other hours of the day. Overall, about 45% of the accidents on I-80 in Solano County over this 3 year period occurred during the six hours of the morning (6:00 to 9:00 AM) and afternoon (3:00 to 6:00 PM) peak periods indicating that high traffic volumes are contributing factors.

Exhibit 3: I-80 Accidents by Time of Day – September 2003 through August 2006



Eastbound and Westbound accidents by type and by segment for I-80 in Solano County are shown in Exhibit 4 and Exhibit 5. At several of the segments along the corridor rear-end collisions are the predominate type of accident that occurs. Accidents of this type are typically associated with congested conditions where stop and go driving takes place either due to recurrent congested conditions, or incidents along the corridor.

Exhibit 4: I-80
Eastbound Accidents by Type – September 2003 through August 2006

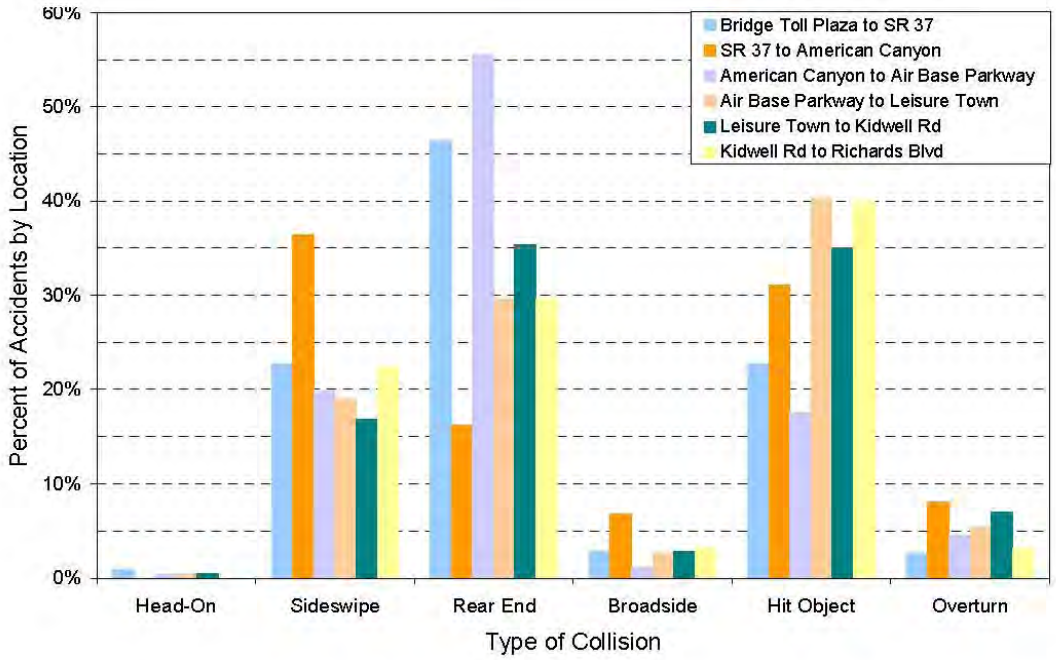
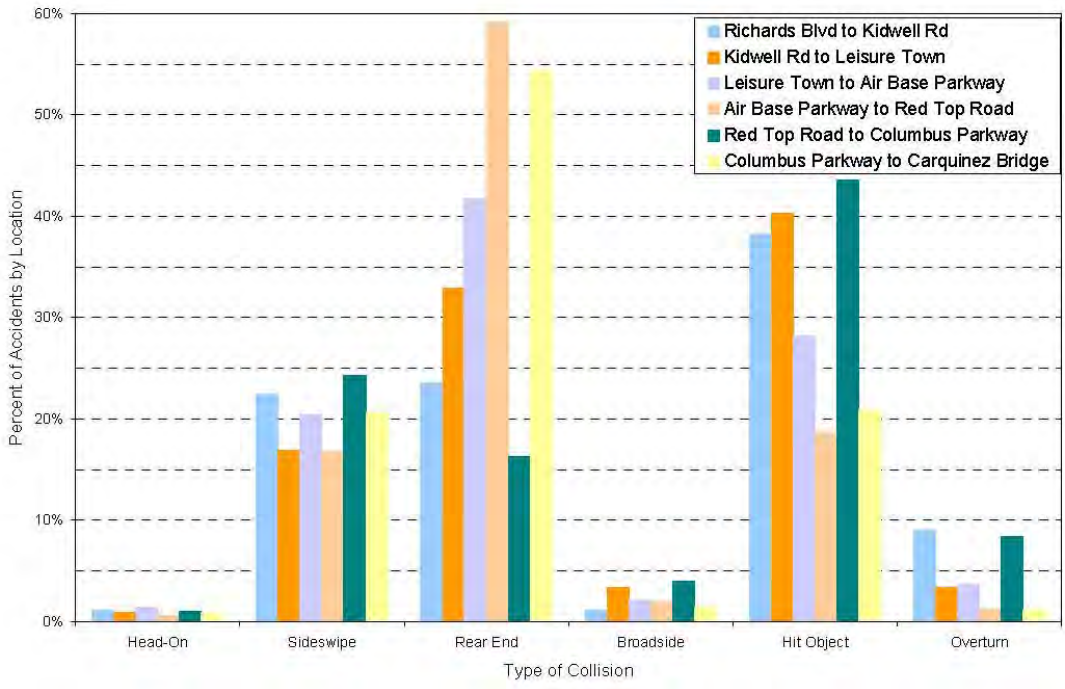


Exhibit 5: I-80
Westbound Accidents by Type – September 2003 through August 2006



3.2.2.2 I-680 Existing Accident Characteristics

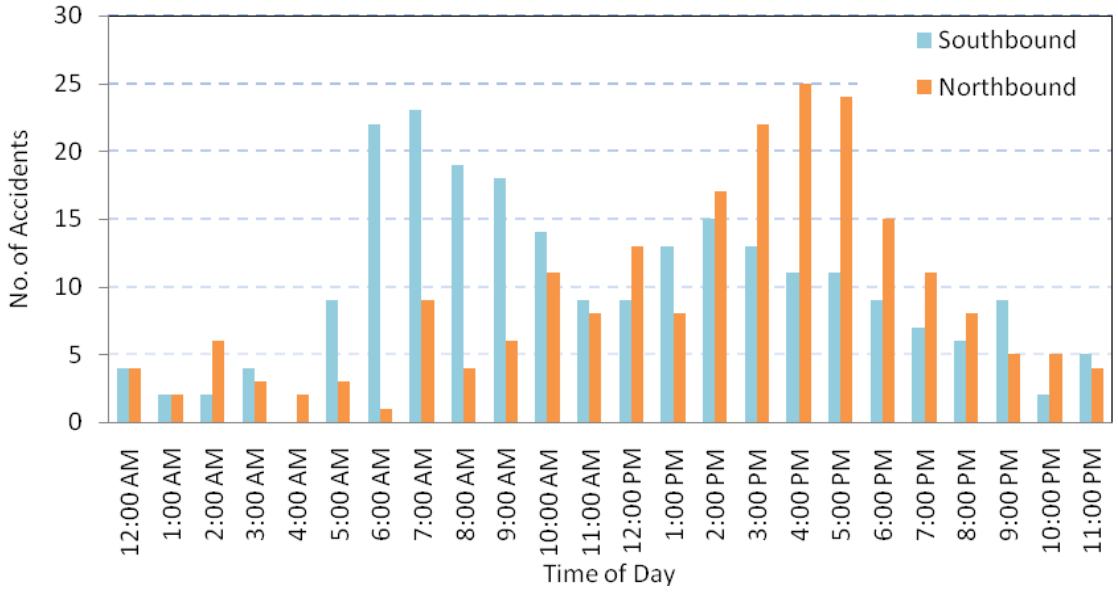
For I-680, accident data for the segment between the Benicia-Martinez Bridge toll plaza and the interchange with I-80 were collected in each direction from September 1, 2003 to August 31, 2006. As shown in Exhibit 6, during this three year period there was a total of 453 accidents reported along the I-680 corridor in Solano County for an average of 1.2 accidents per day. Of these, 127 were reported as injury accidents and 3 were reported as fatalities. Shown in Exhibit 6, accident rates for both directions of I-680 in Solano County are below the statewide average accident rates for similar facilities and area types. This may be due to the relatively low level of congestion, on the whole, along I-680 through the county.

Exhibit 6: I-680 Accident Summary – September 2003 through August 2006

Direction				Segment Length (Miles)	No. of Accidents			Accident Rates (No. of Accidents per Million Vehicle Miles)					
					Segment Quantity			Segment Rates			Statewide Rates		
					Total	Fat	Inj	Fatal	Fatal + Injury	Total	Fatal	Fatal + Injury	Total
Bridge Toll Plaza	to	I-680/I-80 Interchange	NB	13.12	216	1	69	0.002	0.16	0.51	0.014	0.32	0.83
I-680/I-80 Interchange	to	Bridge Toll Plaza	SB	13.12	237	2	58	0.004	0.12	0.49	0.014	0.32	0.84
				Total	453	3	127						

Accidents on I-680 in Solano County by time of day and direction of travel are shown in Exhibit 7 where it can be seen that the pattern of accidents closely correlates to the pattern of hourly traffic volumes along the corridor. In other words, more accidents occur during those hours when the traffic flows are peaking in the morning and afternoon than during other hours of the day. Overall, about 41% of the accidents on I-680 in Solano County over this 3 year period occurred during the six hours of the morning (6:00 to 9:00 AM) and afternoon (3:00 to 6:00 PM) peak periods indicating that high traffic volumes are contributing factors.

Exhibit 7: I-680 Accidents by Time of Day – September 2003 through August 2006



Northbound and Southbound accidents by type and by direction for I-680 in Solano County are shown in Exhibit 8 and Exhibit 9. Along the corridor, hit-object collisions are the predominate type

of accident that occurs. Accidents of this type are typically associated with poor sight line conditions or high vehicle speeds.

Exhibit 8: I-680 Northbound Accidents by Type – September 2003 through August 2006

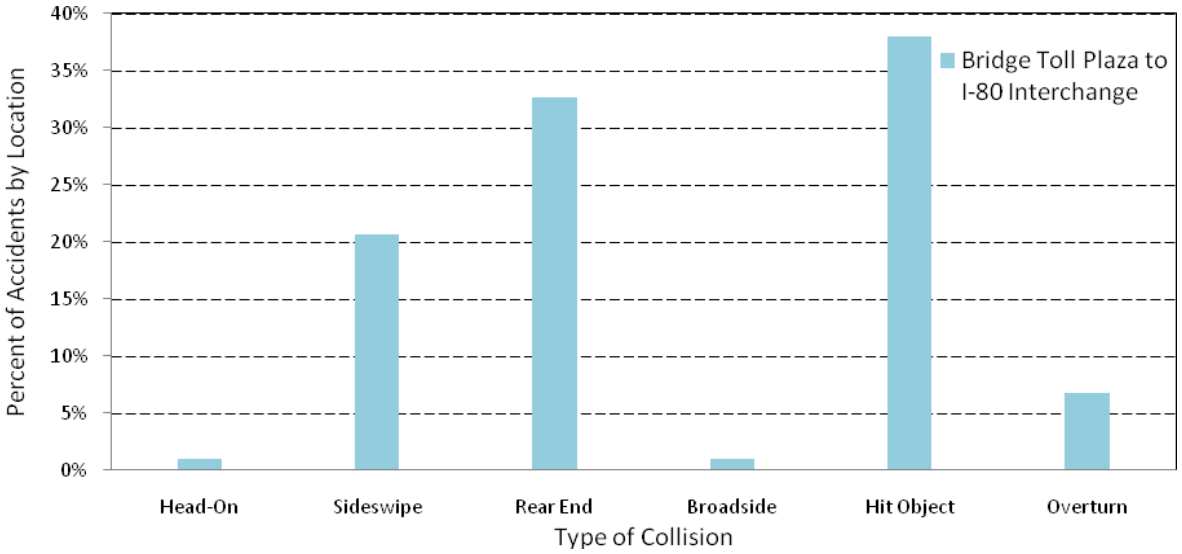
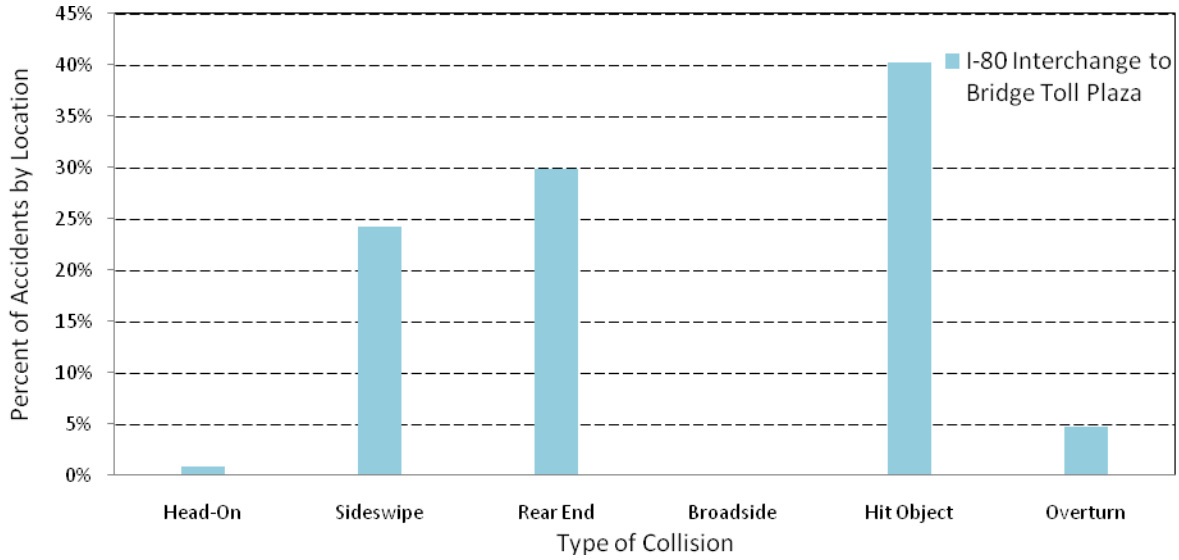


Exhibit 9: I-680 Southbound Accidents by Type – September 2003 through August 2006



3.2.2.3 I-780 Existing Accident Characteristics

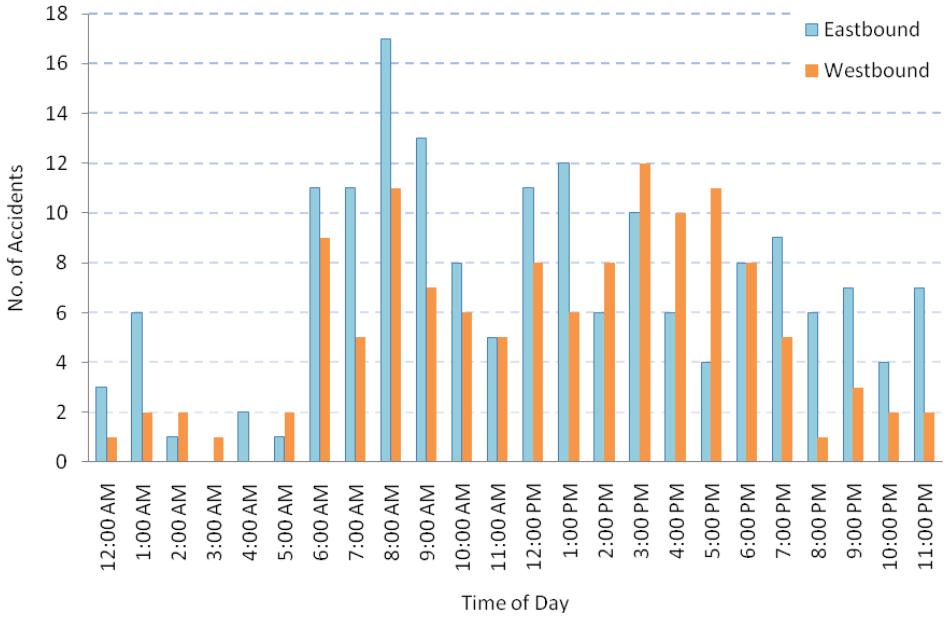
For I-780, accident data for the segment between the Benicia-Martinez Bridge toll plaza and the interchange with I-80 were collected in each direction from April 1, 2005 to March 31, 2008. As shown in Exhibit 10, during this three year period there was a total of 296 accidents reported along the I-780 corridor in Solano County for an average of 0.8 accidents per day. Of these, 109 were reported as injury accidents and 3 were reported as fatalities. Shown in Exhibit 10, accident rates for both directions of I-780 in Solano County are below the statewide average accident rates for similar facilities and area types. This may be due to the relatively low level of congestion along I-780 and the short length of I-780.

Exhibit 10: I-780 Accident Summary – April 2005 through March 2008

Direction				Segment Length (Miles)	No. of Accidents			Accident Rates (No. of Accidents per Million Vehicle Miles)					
					Segment Quantity			Segment Rates			Statewide Rates		
					Total	Fat	Inj	Fatal	Fatal + Injury	Total	Fatal	Fatal + Injury	Total
I-780/I-80 Interchange	to	Bridge Toll Plaza	EB	6.51	169	1	60	0.005	0.30	0.83	0.011	0.36	0.98
Bridge Toll Plaza	to	I-780/I-80 Interchange	WB	6.51	127	2	49	0.010	0.25	0.62	0.011	0.36	0.98
				Total	296	3	109						

Accidents on I-780 by time of day and direction of travel are shown in Exhibit 11 where it can be seen that the pattern of accidents closely correlates to the pattern of hourly traffic volumes along the corridor. More accidents occur during those hours when the traffic flows are peaking in the morning and afternoon than during other hours of the day. Overall, about 40% of the accidents on I-780 over this 3 year period occurred during the six hours of the morning (6:00 to 9:00 AM) and afternoon (3:00 to 6:00 PM) peak periods indicating that high traffic volumes are contributing factors.

Exhibit 11: I-780 Accidents by Time of Day – April 2005 through March 2008



Eastbound and Westbound accidents by type and by direction for I-780 are shown in Exhibit 12 and Exhibit 13. Along the corridor, hit-object collisions are the predominate type of accident that occurs. Accidents of this type are typically associated with poor sight line conditions or high vehicle speeds.

Exhibit 12: I-780 Eastbound Accidents by Type – April 2005 through March 2008

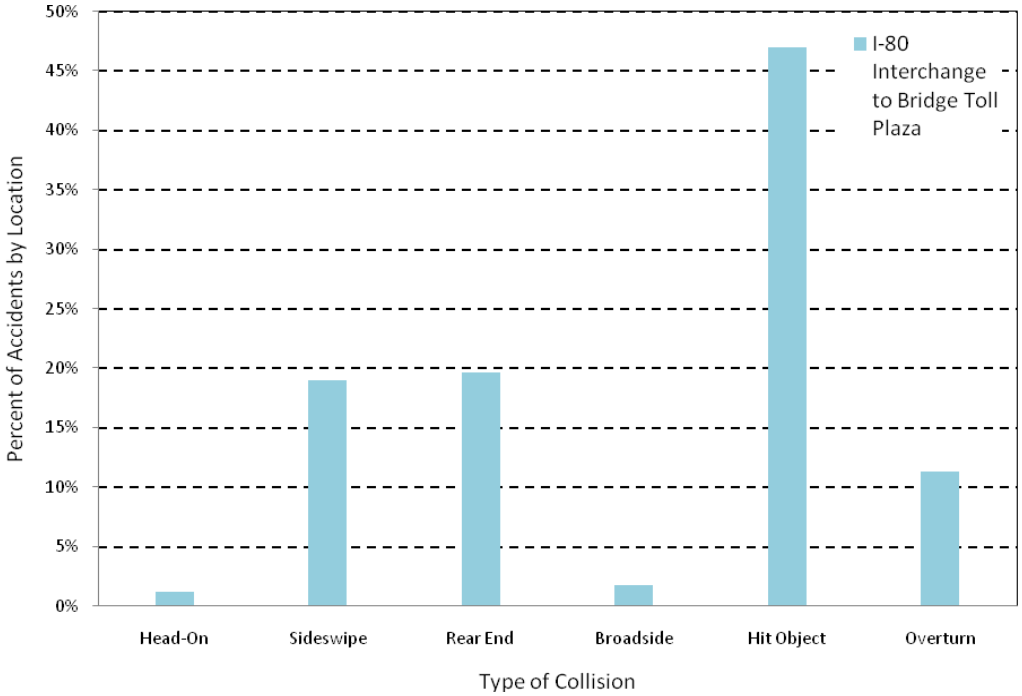
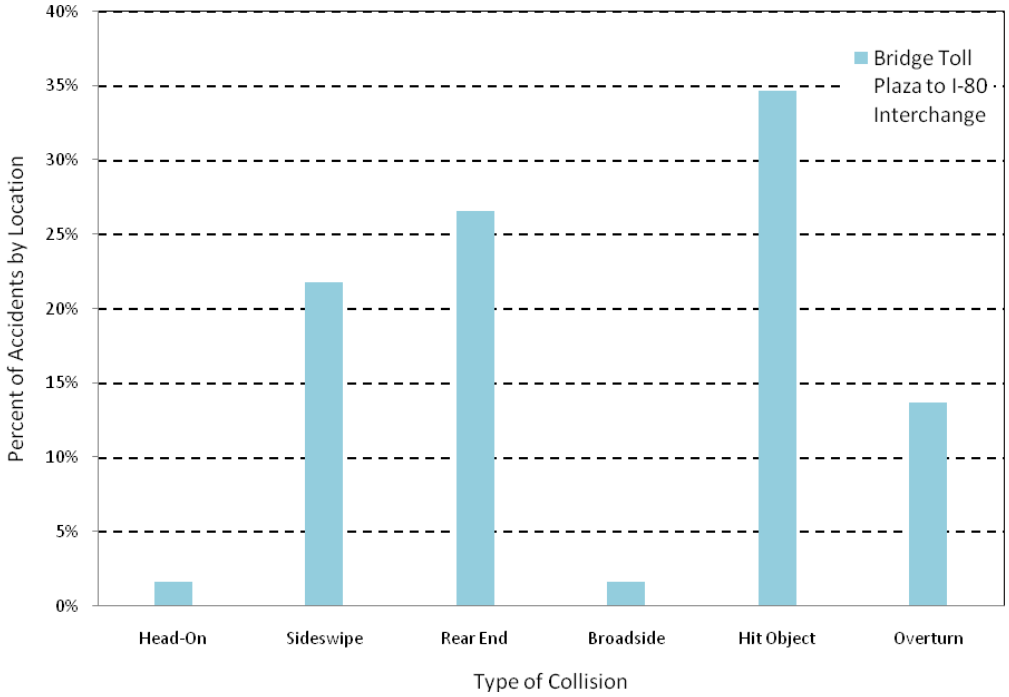


Exhibit 13: I-780 Westbound Accidents by Type – April 2005 through March 2008



3.3 Future Year Conditions

This section summarizes the projected future year recurring congestion conditions for the I-80, I-680, and I-780 corridors within Solano County for two forecast years: 2015 and 2030. A majority of the information reported in this section was taken from the I-80 & I-680 FPI reports, supplemented by new primary analysis of conditions on I-780.

For this future year assessment, it is expected that roadway geometries, capacities, and other interstate characteristics will change as projects are completed. As part of the I-80 FPI future conditions, four fully funded projects were assumed for both the 2015 and 2030 analyses:

- I-80 HOV Lanes Project (Red Top Road to Air Base Parkway)
- State Route 12 West Truck Climbing Lane Project
- Jameson Canyon Widening Project
- Westbound I-80 Auxiliary lane from Reconfigured Monte Vista Avenue on/off-ramps to I-505

For I-680 and I-780, the 2015 and 2030 analysis assumed completion of the improvements to the I-680 and I-780 approaches to the Benicia-Martinez Bridge. Consistent with the I-680 FPI study, the 2030 analysis also assumed improvements at the I-80/I-680 junction, including a higher-capacity connector from northbound I-680 to eastbound I-80.

3.3.1 Year 2015 Conditions

Freeway segments where recurring AM or PM peak period congestion is forecast for the Year 2015 are illustrated in Exhibit 14 and described below.

3.3.1.1 I-80 Conditions

With the funded improvements operational by 2015, the FPI identified two congestion locations along I-80 in 2015. Both are projected to occur during the PM peak period in the eastbound direction of travel approaching Vacaville.

PM Peak:

- Location 1: Eastbound between North Texas Street and Truck Scales off ramp.
- Location 2: Eastbound between Pleasant Valley Road on ramp and Cherry Glen Road

Eastbound congestion would extend 6.8 miles between North Texas Street and the Truck Scales off ramp is due to a bottleneck in the segment between the North Texas Street on ramp and the Cherry Glen Road off ramp. The second eastbound queue between the Pleasant Valley Road on ramp and Cherry Glenn Road would extend 0.7 miles and would be a result of a bottleneck between the Pleasant Valley Road to I-80 on ramp and the Alamo Drive off ramp.

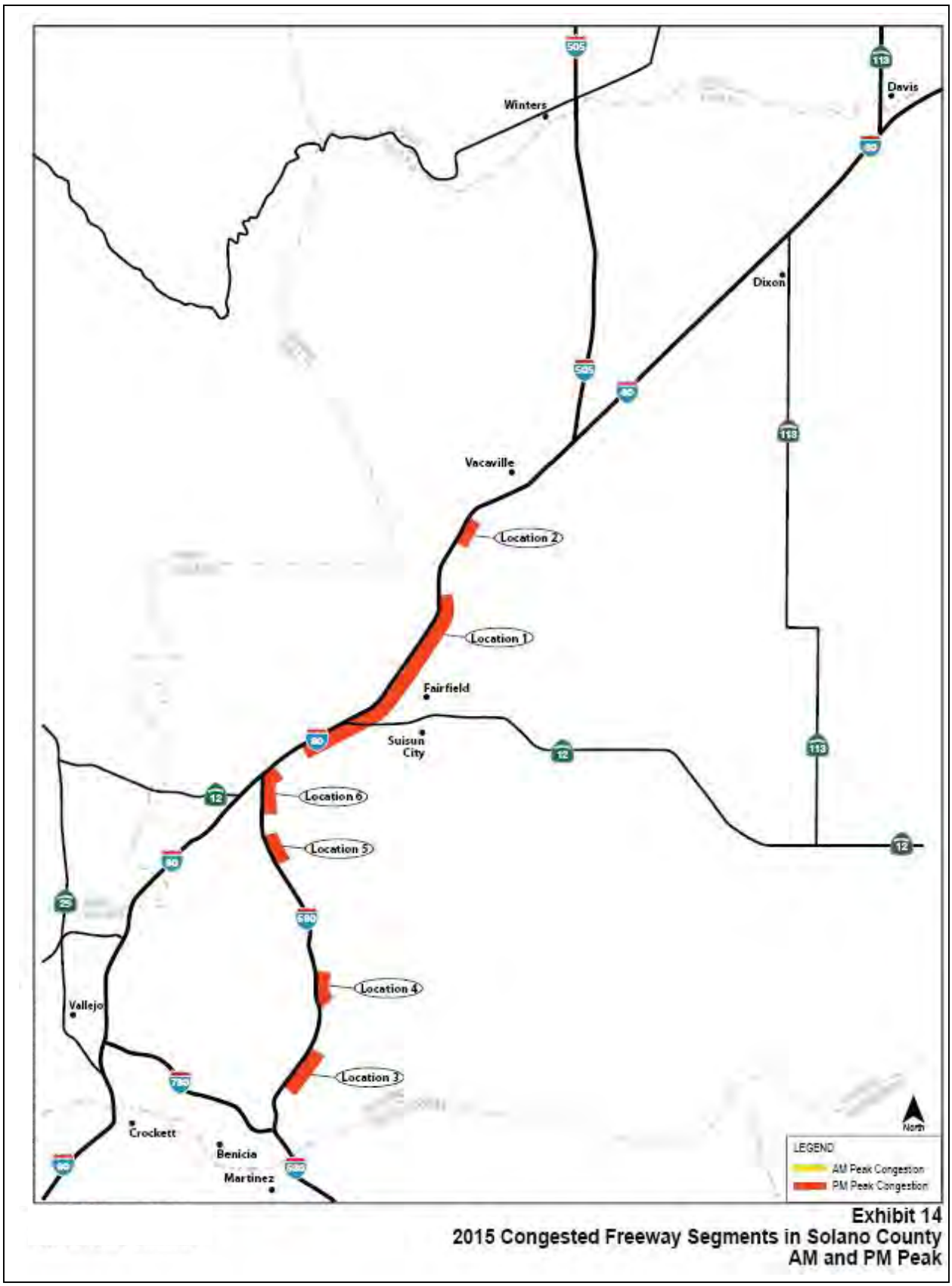


Exhibit 14
2015 Congested Freeway Segments in Solano County
AM and PM Peak

3.3.1.2 I-680 Conditions

As shown in Exhibit 14, according to the I-680 FPI study, no congestion is projected on I-680 during the AM peak. During the PM peak, however, congestion is projected for four segments on northbound I-680 in Solano County.

PM Peak Hour

- Location 3: Northbound from the Lake Herman Road to Industrial Way
- Location 4: Northbound from Parish Road to Morrow Lane
- Location 5: Northbound from Gold Hill Road to Summerset Drive
- Location 6: Northbound from the I-80 interchange to Red Top Road

For the first three of these locations, congestion occurs as a result of bottlenecks that form when high mainline traffic demand is combined with traffic entering I-680 from the respective on-ramps at Lake Herman Road, Parish Road, and Gold Hill. The northbound congestion just south of the I-80 interchange would be due to the capacity constraint at the merge onto I-80.

3.3.1.3 I-780 Conditions

The FREQ model indicated no mainline congestion in either the westbound or eastbound directions during either peak period. However, similar to existing conditions, slowing is expected in the westbound direction approaching the I-80. The high exiting volumes to I-80 combined with high traffic on I-80 result in slowing on the off-ramps that extends back to the right lane on the I-780 mainline. During the AM peak, this occurs primarily at the loop off-ramp to westbound I-80, while during the PM peak the diagonal off-ramp to eastbound I-80 is most affected. At the eastern end of I-780, it is expected that the slowing that currently occurs will be eliminated as improvements to the bridge approach geometry are completed.

3.3.1 Year 2030 Conditions

Freeway segments where recurring AM or PM peak period congestion is forecast for the Year 2030 are illustrated in Exhibit 15 and described below.

3.3.1.1 I-80 Conditions

Under future 2030 conditions, the FPI report identified four congested locations along I-80 as listed below and shown in Exhibit 15.

AM Peak Hour

- Location 1: Westbound from SR 29 on-ramp to the rest stop east of Columbus Parkway
- Location 2: Westbound from west of Suisun Valley Road to west of Leisure Town Road

PM Peak Hour

- Location 3: Eastbound from Pleasant Valley Road on ramp to the south side of the Carquinez Bridge.
- Location 4: Eastbound from the causeway east of the Webster Street on ramp to west of Richards Boulevard.

During the AM peak period, two congested segments were identified in the westbound direction of I-80. The first of these segments extends 5.6 miles between SR 29 on ramp and the rest stop east of Columbus Parkway, and is due to a bottleneck in the three lane section of I-80 west of the SR 29 on ramp. Reaching 14.8 miles, the second congested segment between west of Suisun Valley Road and west of Leisure Town Road is due to a bottleneck between the SR 12 on ramp and the Suisun Valley Road off ramp.

In the PM peak period, the FPI report identified two congested segments in the eastbound direction of I-80. The worst of these is the segment between Pleasant Valley Road on ramp and the south side of Carquinez Bridge. This congested segment extends 25 miles and is due to a bottleneck between the Pleasant Valley Road on ramp and the Alamo Drive off ramp. The second congested segment is the 6.1-mile section between the causeway east of the Webster Street on ramp and west of Richards Boulevard. This congestion occurs due to a bottleneck on the Causeway east of where the Webster Street on ramp joins eastbound I-80.

Exhibit 15
2030 Congested Freeway Segments in Solano County AM and PM Peak

3.3.1.2 I-680 Conditions

The 2030 analysis conducted as part of the I-680 North FPI study results has not yet been approved by the MTC. However, for completeness, these results are cited here to describe forecasted conditions on I-680 for the Year 2030. As shown in Exhibit 15, recurring congestion is forecasted at four locations along I-680 in Solano County in the Year 2030:

AM Peak:

- Location 5: Southbound from south of the Stone Valley Road interchange in Contra Costa County to north of the Parish Road interchange in Solano County
- Location 6: Southbound from the Marshville Road interchange to the I-80 interchange

PM Peak:

- Location 7: Northbound from the Lake Herman Road interchange in Solano County to the Alcosta Boulevard interchange at the southern end of Contra Costa County
- Location 8: Northbound from the Parish Road interchange to the Lake Herman Road interchange
- Location 9: Northbound from the Gold Hill Road interchange to the Marshville Road interchange

During the AM peak, the increased travel demand expected for 2030 will greatly increase the severity of congestion in Contra Costa County resulting in queues that spill back into Solano County. In Contra Costa County, the southbound queue from the bottleneck south of the Stone Valley Road interchange is projected to overlap with that from the bottleneck at the lane drop just south of the North Main Street off ramp. This combined queue is projected to extend back into Solano County, past the Parish Road interchange. The additional congestion between the Marshville Road interchange and the I-80 interchange would be due to a bottleneck at the Marshville Road on-ramp.

In the PM peak, increased demand will result in considerable congestion in the northbound direction on I-680 in Solano County. Congestion occurs as a result of bottlenecks that form when high mainline traffic demand is combined with traffic entering I-680 from the respective on-ramps at Lake Herman Road, Parish Road, and Gold Hill road. The analysis conducted for the I-680 North FPI study indicates that the entire stretch of I-680 northbound between the Parish Road interchange and the Alcosta Boulevard interchange will be congested as the product of seven overlapping queues.

3.3.1.3 I-780 Conditions

The 2030 FREQ analysis conducted for the I-780 corridor indicates congestion in four locations as listed below and shown in Exhibit 15.

AM Peak Hour

- Location 10: Eastbound between East 5th Street and East 2nd Street
- Location 11: Westbound between Cedar on-ramp to Columbus on-ramp

PM Peak Hour

- Location 12: Eastbound between Columbus on-ramp to east of Glen Cove on-ramp
- Location 13: Eastbound between Spruce on-ramp to off-ramp to eastbound I-80

In each of these cases, congestion is forecast to occur as a result of bottlenecks that form when high mainline traffic demand is combined with traffic entering I-780 from the respective on-ramps at the downstream end of each congested segment.

3.4 Operational Improvements

This section identifies operational improvement strategies intended to address both existing and future performance deficiencies on the freeway facilities identified above. This analysis is based largely on information from prior studies, notably the Solano I-80 Corridor Freeway Performance Initiative study and the I-680 North Corridor Freeway Performance Initiative study. Additionally, operational analysis of the I-780 corridor was performed specifically for this effort.

The remainder of this section is organized around separate chapters for each freeway corridor. Within each chapter performance degradation issues and potential improvements strategies for both 2015 and 2030 are presented. Potential improvement strategies include providing and/or extending auxiliary and HOV lanes, constructing braided ramps, and improving interchange geometry and connections. In addition, ITS technologies such as cameras, changeable message signs, traffic detection, and ramp metering are suggested as operational improvement strategies.

I-80, I-680, and I-780 represent the main freeway corridors in Solano County directly connecting the cities of Benicia, Vallejo, Fairfield, Vacaville, and Dixon to the San Francisco Bay Area and the Sacramento region. These facilities serve a number of users, including, but not limited to: goods movement, commuter traffic, regional through trips, intercity travel and recreational traffic.

It is important to note that the purpose of this report is to identify operational improvement strategies intended to address both existing and future performance deficiencies on these facilities. Prioritization of these strategies is presented in Section 5, Implementation Plan.

3.5 I-80 corridor

3.5.1 Year 2015

3.5.1.1 Operating Conditions

As identified in the I-80 FPI future conditions, four fully funded projects are assumed for the 2015 analysis:

- I-80 HOV Lanes Project (Red Top Road to Air Base Parkway)
- State Route 12 West Truck Climbing Lane Project
- Jameson Canyon Widening Project
- Westbound I-80 Auxiliary lane from Reconfigured Monte Vista Avenue on/off-ramps to I-505

With these four fully funded projects, the Performance Degradation Report and the I-80 FPI state that no congested segments occur during the AM peak hour while two congested segments occur during the PM peak hour in the year 2015.

- Eastbound between North Texas Street and Truck Scales off ramp
- Eastbound between Pleasant Valley Road and Cherry Glen Road

Within these two congested segments, there are two bottlenecks. These bottlenecks and their causes are listed in Exhibit 1 below.

Exhibit 1: 2015 I-80 Bottleneck Locations

No	Location	Details
1	Eastbound between North Texas St and Cherry Glenn Rd	This bottleneck occurs when high eastbound volumes in the three general purpose lanes combine with the North Texas on-ramp traffic at this location.
2	Eastbound between Pleasant Valley Rd and Alamo Dr	This bottleneck occurs where the Pleasant Valley Road on-ramp traffic joins with the three eastbound general purpose lanes at this location.

Flow rates and demand volumes, measured in vehicles per hour (vph) were examined in the I-80 FPI for the bottlenecks described above and within the projected queues resulting from these bottlenecks. The evaluation revealed that both of these locations would need to be addressed simultaneously since mitigating the bottleneck at North Texas Street simply moves the controlling bottleneck downstream to Pleasant Valley Road. The analysis also revealed two upstream embedded bottlenecks: eastbound between Air Base Pkwy and North Texas St, and eastbound between the truck scales on-ramp and the SR 12. Finally, the analysis in the I-80 FPI also shows constrained flows at the interchange ramp terminal where I-680 joins I-80, while field observations at the SR 12 east off-ramp reveal back-ups that result from queues at the signalized downstream intersections – most notably Beck Avenue.

3.5.1.2 Operational Improvement Strategies

The I-80 FPI study suggested a combination of strategies to address the congestion and bottlenecks described above. These operational improvement strategies are detailed in Exhibit 2 below.

Exhibit 2: 2015 I-80 Operational Improvement Strategies

Strategy	Location and Details
HOV Lane	Extend the programmed eastbound HOV-2 lane from between Air Base Pkwy and North Texas St to Alamo Dr
Ramp Metering	Install on local service interchanges (eastbound and westbound) between Air Base Pkwy and Alamo Dr
	Install at the I-80 eastbound Green Valley Rd and Suisun Valley Rd interchanges
Auxiliary Lane	Provide in the eastbound direction between Travis Blvd and Air Base Pkwy
	Provide in the eastbound direction between Pleasant Valley Rd and Alamo Dr with a two-lane off ramp at Alamo Dr
	Provide additional capacity equivalent of one, eastbound through lane at the intersection of SR 12 East and

Exhibit 2: 2015 I-80 Operational Improvement Strategies	
Strategy	**Location and Details**
	Beck Avenue
ITS	Assess gaps in the current and programmed ITS installations and supplement as needed. (Areas include between SR 29 and SR 37 in Vallejo and from Red Top Road to Air Base Parkway)
	Extend coverage to fill the gap between SR 37 and Red Top Road
	Extend coverage eastward from Air Base Parkway to the Solano/Yolo County line.

3.5.2 Year 2030

3.5.2.1 Operating Conditions

As identified in the I-80 FPI future conditions, four fully funded (programmed) projects are assumed for the 2015 analysis and also for the 2030 analysis:

- I-80 HOV Lanes Project (Red Top Road to Air Base Parkway)
- State Route 12 West Truck Climbing Lane Project
- Jameson Canyon Widening Project
- Westbound I-80 Auxiliary lane from Reconfigured Monte Vista Avenue on/off-ramps to I-505

With these improvements for 2030, the I-80 FPI and performance degradation section state that four congested segments occur during the AM and PM peak hours in the year 2030.

AM Peak Hour

- Westbound from SR 29 on-ramp to the rest stop east of Columbus Parkway
- Westbound from west of Suisun Valley Road to west of Leisure Town Road

PM Peak Hour

- Eastbound from Pleasant Valley Road on ramp to the south side of the Carquinez Bridge.
- Eastbound from the causeway east of the Webster Street on ramp to west of Richards Boulevard.

Within these four congested segments, there are four bottlenecks that are expected to occur by 2030. These bottlenecks and their causes are listed in Exhibit 3.

Exhibit 3: 2030 I-80 Bottleneck Locations		
No	**Location**	**Details**
1	Eastbound between Pleasant Valley Rd and Alamo Dr	This bottleneck location is the same as in 2015 analysis and occurs when high eastbound volumes in the four general purpose lanes combine with the Pleasant Valley road on-ramp traffic at this location.
2	Eastbound at the County Road 32A / 32B (Webster Rd) interchange (three lane segment west of the SR 29 on-ramp)	This bottleneck is where the 32A/32B location joins the heavily traveled segment of I-80 approaching the Yolo Causeway. By 2030, this bottleneck is expected to occur regularly on typical weekdays due to traffic growth on the I-80 corridor and due to the addition of capacity

Exhibit 3: 2030 I-80 Bottleneck Locations		
No	**Location**	**Details**
		on I-80 upstream that will allow demand to reach this location.
3	Westbound at SR 29 (includes the causeway section east of the Webster street interchange)	This bottleneck location is where the westbound SR 29 on-ramp joins I-80.
4	Westbound between the SR 12 East on-ramp and the truck scales off-ramp	This bottleneck is in the I-80/I-680/SR 12 interchange area. While the specific location is identified as between the truck scales and SR 12 East, it is effectively between Suisun Valley Road and SR 12 East because of the characteristics of the traffic entering and exiting at the truck scales.

It should be noted that for Location 2, operational improvement measures for this bottleneck location would need to include additional capacity (either an HOV or a general purpose lane) on the Yolo Causeway. However, specific recommendations were not provided in the I-80 FPI since this bottleneck and associated queue are located outside of Solano County.

The controlling bottleneck in the eastbound direction of travel is located between Pleasant Valley Road and Alamo Drive (Location 1). At this location, the 2030 mainline demand volume is 10,800 vph compared to the current capacity of this mixed-use four-lane section which is about 8,000 vph. The queue that results from this bottleneck is projected to extend 25 miles to the western limits of the study area at the Carquinez Bridge. There are also bottlenecks that occur downstream of this location and upstream embedded bottlenecks within the resulting queue. These bottlenecks are from Alamo Drive to Allison Drive, from Air Base Parkway to North Texas Street, and the I-80/I-680/SR 12 interchange area. Additionally, bottlenecks occur from the Tennessee Street on-ramp to Redwood Parkway, SR 29 to Sequoia Ave, and Midway Road to Dixon Avenue.

In the westbound direction, in addition to the two controlling bottlenecks, there is also an upstream bottleneck between Abernathy Road and West Texas Street and a downstream bottleneck at the Carquinez Bridge and slightly west of the bridge.

3.5.2.2 Operational Improvement Strategies

Operational improvement strategies from the I-80 FPI for congestion are suggested for both directions of I-80. Eastbound operational improvement strategies are detailed in Exhibit 4 while the westbound strategies are shown in Exhibit 5.

Exhibit 4: 2030 I-80 Eastbound Operational Improvement Strategies	
Strategy	**Location and Details**
General Purpose Lane	Provide a fifth eastbound general purpose lane extending from SR 12 East to Air Base Parkway.
	Provide a fourth eastbound general purpose lane extending from Leisure Town Road to west of SR 113 (the existing four-lane section is between Pedrick Road and Kidwell Road)
	The segment between SR 12 West and I-680 should include five eastbound general use lanes
	The segment between SR 12 East and I-680 should include six eastbound general purpose lanes
	Extend the fourth eastbound general purpose lane from the SR 29 off-ramp to the Sequoia Avenue off-ramp
Auxiliary Lane	Maintain the eastbound auxiliary lane between Abernathy Road and West Texas Street
	Provide an eastbound auxiliary lane between Cliffside Drive and Allison Drive with a two-lane off-ramp at Allison Drive

Exhibit 4: 2030 I-80 Eastbound Operational Improvement Strategies	
Strategy	**Location and Details**
	Provide an eastbound auxiliary lane between Cherry Glenn Road and Pleasant Valley Road
	Provide as necessary between SR 12 West and I-680 and I-680 and SR 12 East and adjust truck scales location within the same general area to improve weave and merge maneuvers
	Provide an eastbound auxiliary lane between the Tennessee Street on-ramp and the Redwood Street off-ramp
	Provide an eastbound auxiliary lane between the I-780 on-ramp and the Georgia Street off-ramp
HOV Lane	Extend the HOV-2 lane from Alamo Drive to I-505.
	Provide EB HOV-2 lane from SR 29 to SR 37
	Provide EB HOV-2 lane from SR 37 to Red Top Road
Ramp Metering	Install ramp metering at all eastbound local access interchanges between Alamo Drive and I-505
	Install in the eastbound direction at local access interchanges in Vallejo between SR 29 and SR 37
Interchange Modifications	Improve the I-680/I-80 interchange connections to address the capacity deficiencies of these ramps by either modifying the current interchange geometry or implementing an alternative configuration
	Provide braided ramp configurations as necessary between I-680 and SR 12 East and adjust truck scales location within the same general area to improve weave and merge maneuvers
	Provide braided ramp configurations as necessary between SR 12 West and I-680 to improve weave and merge maneuvers
	Identify and improve geometry and access between SR 29 and SR 37 in the eastbound direction by consolidating or removing access points and improving merge and diverge areas

Exhibit 5: 2030 Westbound I-80 Operational Improvement Strategies	
Strategy	**Location and Details**
General Purpose Lane	Between I-680 and SR 12 West the section should include five westbound general use lanes
	Between SR 12 East and I-680, the section should include five westbound general use lanes
	From SR 12 East to West Texas Street, a fifth westbound general purpose lane should be included.
	From east of Leisure Town Road to west of Kidwell Road, a fourth westbound general purpose lane should be included
Auxiliary Lane	Provide a westbound auxiliary lane between Air Base Parkway and Travis Boulevard
	Provide a westbound auxiliary lane between North Texas Street and Air Base Parkway
	Provide a westbound auxiliary lane between Alamo Drive and Pleasant Valley Road
HOV Lane	
	Extend the westbound HOV-2 lane from Air Base Parkway to I-505

Exhibit 5: 2030 Westbound I-80 Operational Improvement Strategies	
Strategy	**Location and Details**
	Extend the HOV-3 lane from the Carquinez Bridge to east of the SR 29 westbound on-ramp
	Extend the HOV-3 lane from east of the SR 29 westbound on-ramp to SR 37
Ramp Metering	Install ramp metering at all westbound local access interchanges between Alamo Drive and I-505.
	Install ramp metering at westbound local access interchanges from I-505 eastward to the Solano / Yolo County Line
	Install in the westbound direction at local access interchanges in Vallejo between SR 29 and SR 37
Interchange Modifications	Identify and improve geometry and access between SR 29 and SR 37 in the westbound direction by consolidating or removing access points and improving merge and diverge areas

3.5.3 Summary

Exhibits 6 through 11 summarize the existing, 2015, and 2030 conditions and the suggested operational improvements for congested segments and bottleneck locations. As shown in the exhibits, the proposed operational improvements would relieve all of the eastbound 2015 congestion (there is no 2015 westbound congestion). These 2015 strategies include HOV lanes, ramp metering, and auxiliary lanes.

Similarly, longer-term strategies would eliminate all 2030 congestion. Operational improvements for 2030 would add general purpose lanes, auxiliary lanes, HOV lanes, ramp metering, and interchange modifications.

It should be noted that while these exhibits do not show the deployment of ITS elements along the I-80 corridor, installation of ITS elements, including the necessary communication system, to fill gaps and cover the entire corridor is recommended as an operational improvement strategy for 2015.

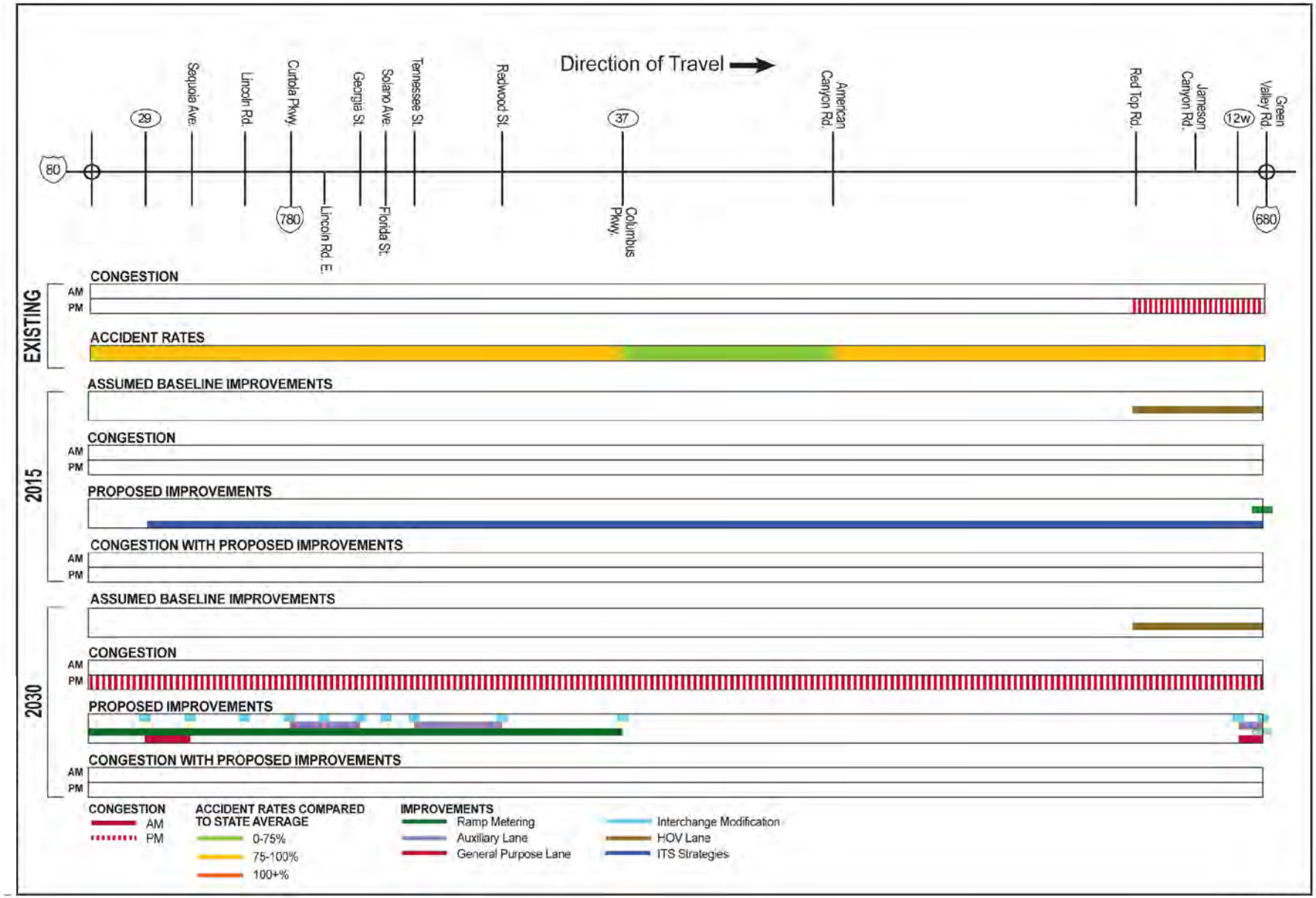


Exhibit 6: I-80 Eastbound between Carquinez Bridge and I-680

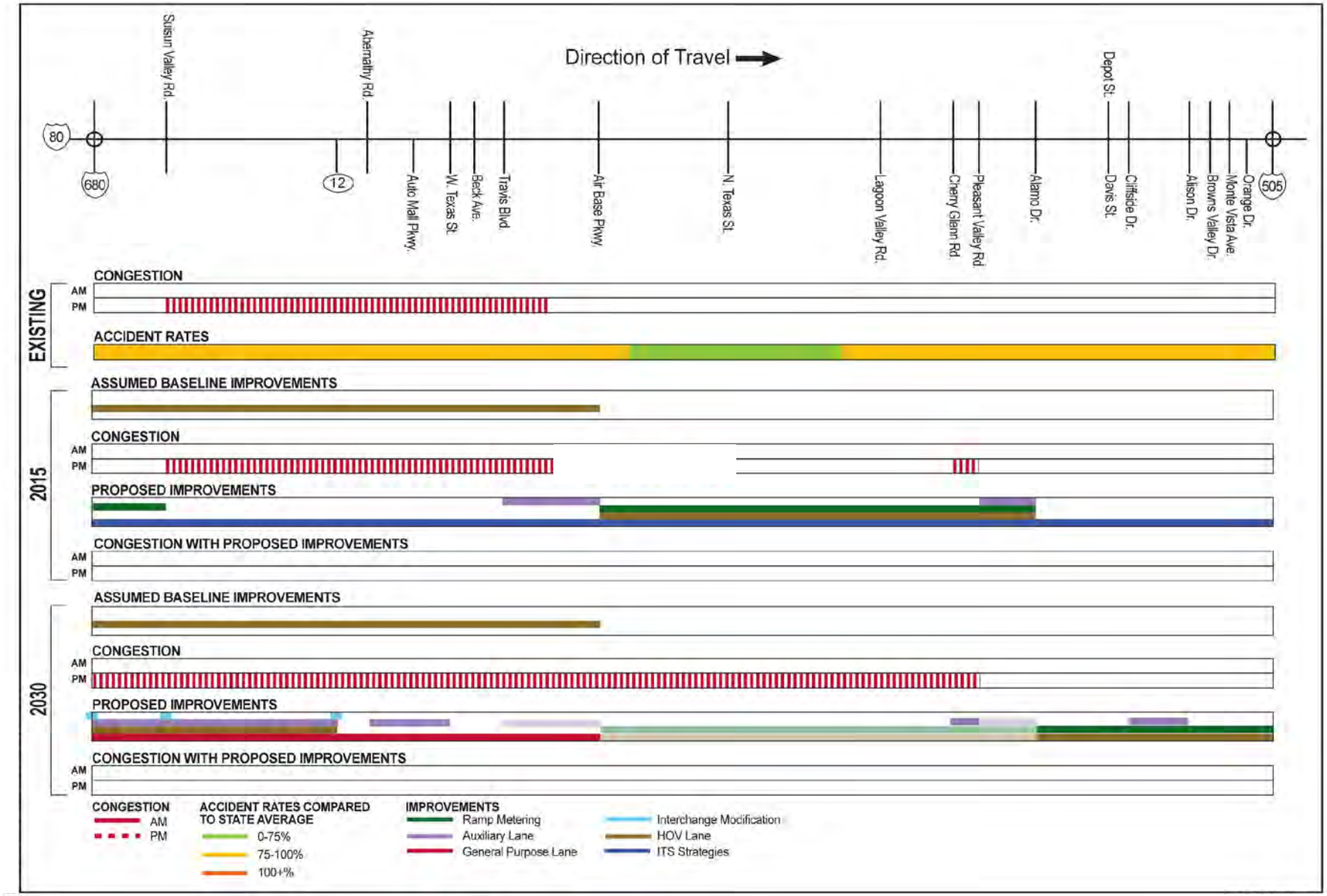


Exhibit 7: I-80 Eastbound between I-680 and I-505

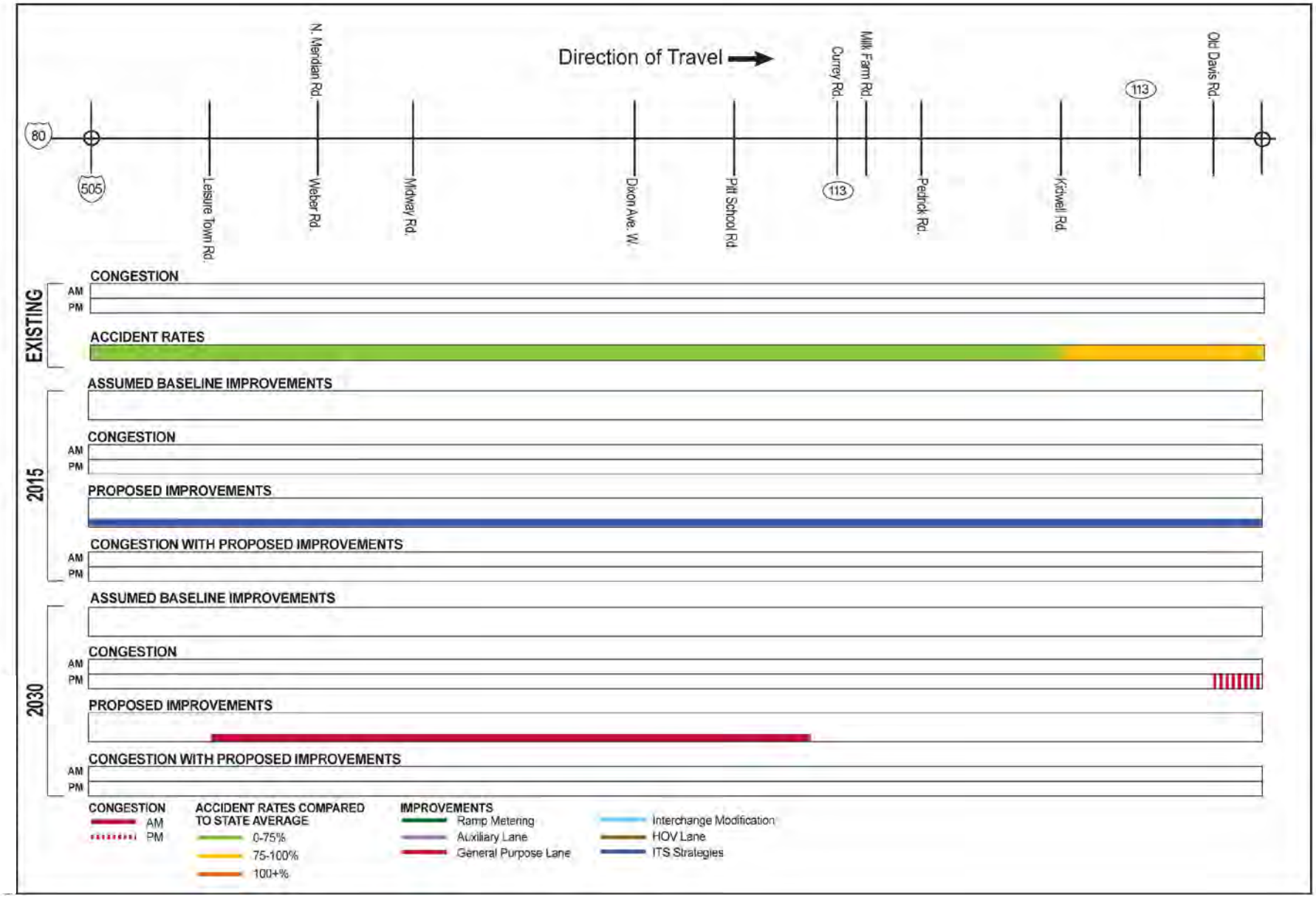


Exhibit 8: I-80 Eastbound I-505 and County Line

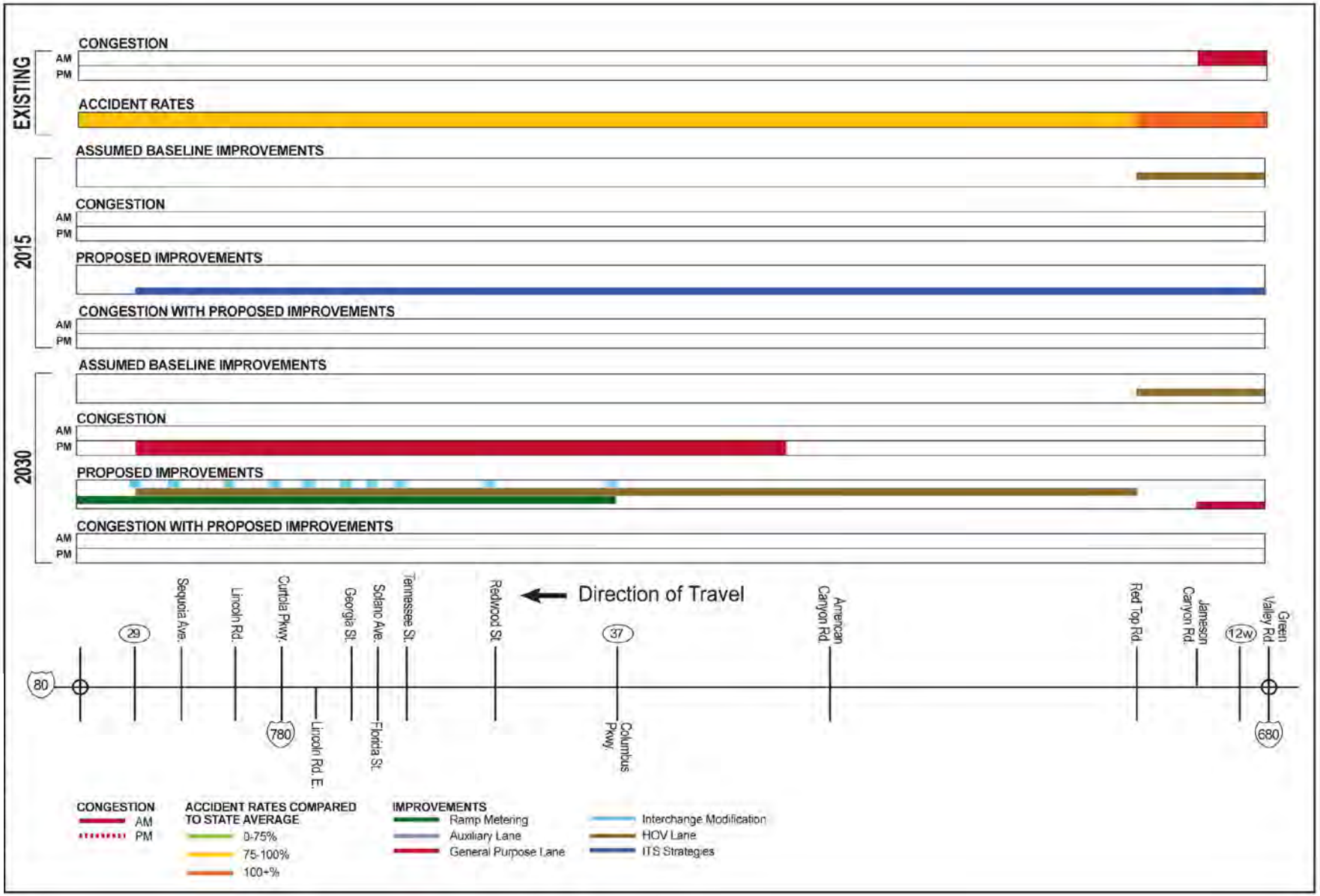


Exhibit 9: I-80 Westbound between I-680 and the Carquinez Bridge

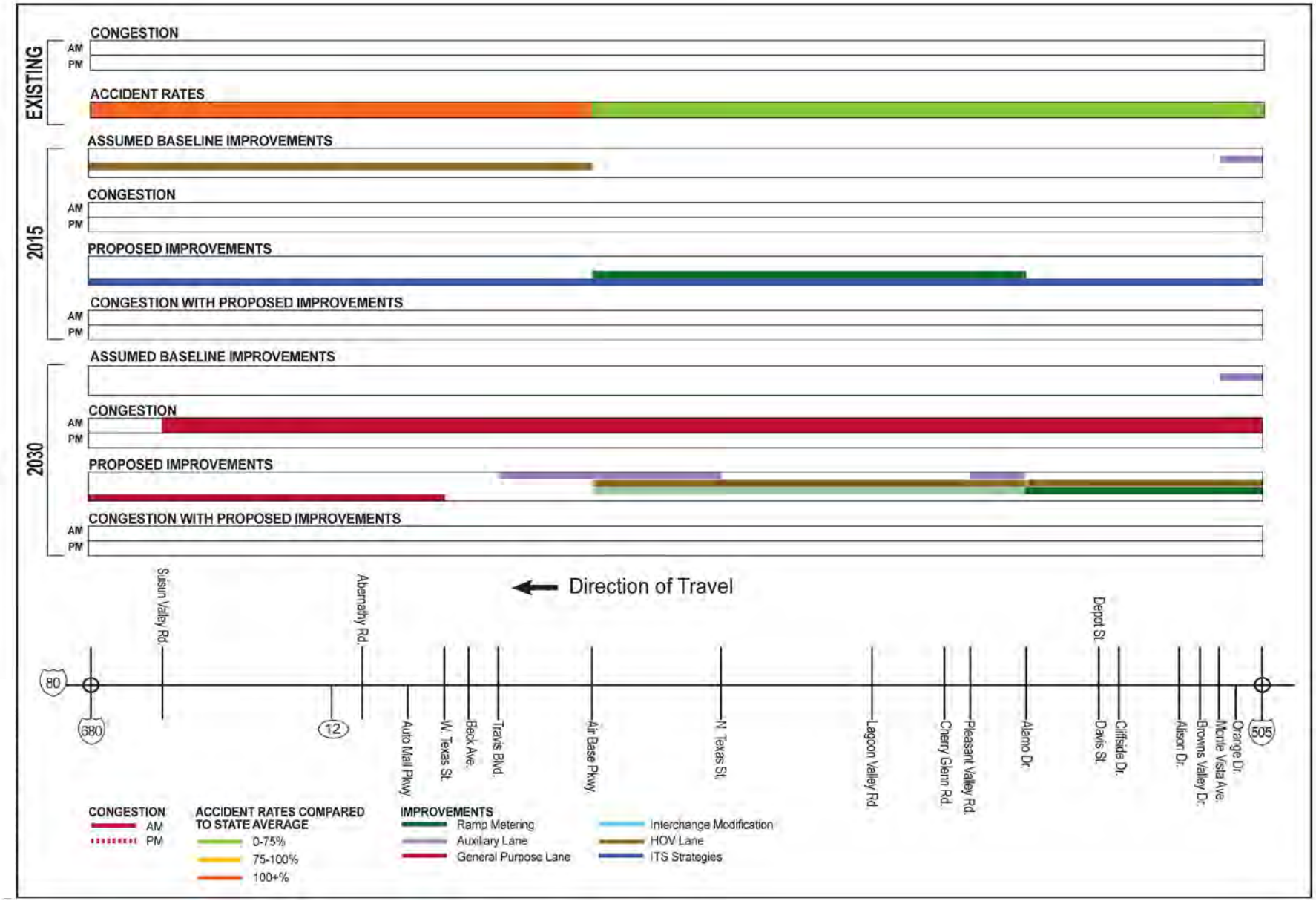


Exhibit 10: I-80 Westbound between I-505 and I-680

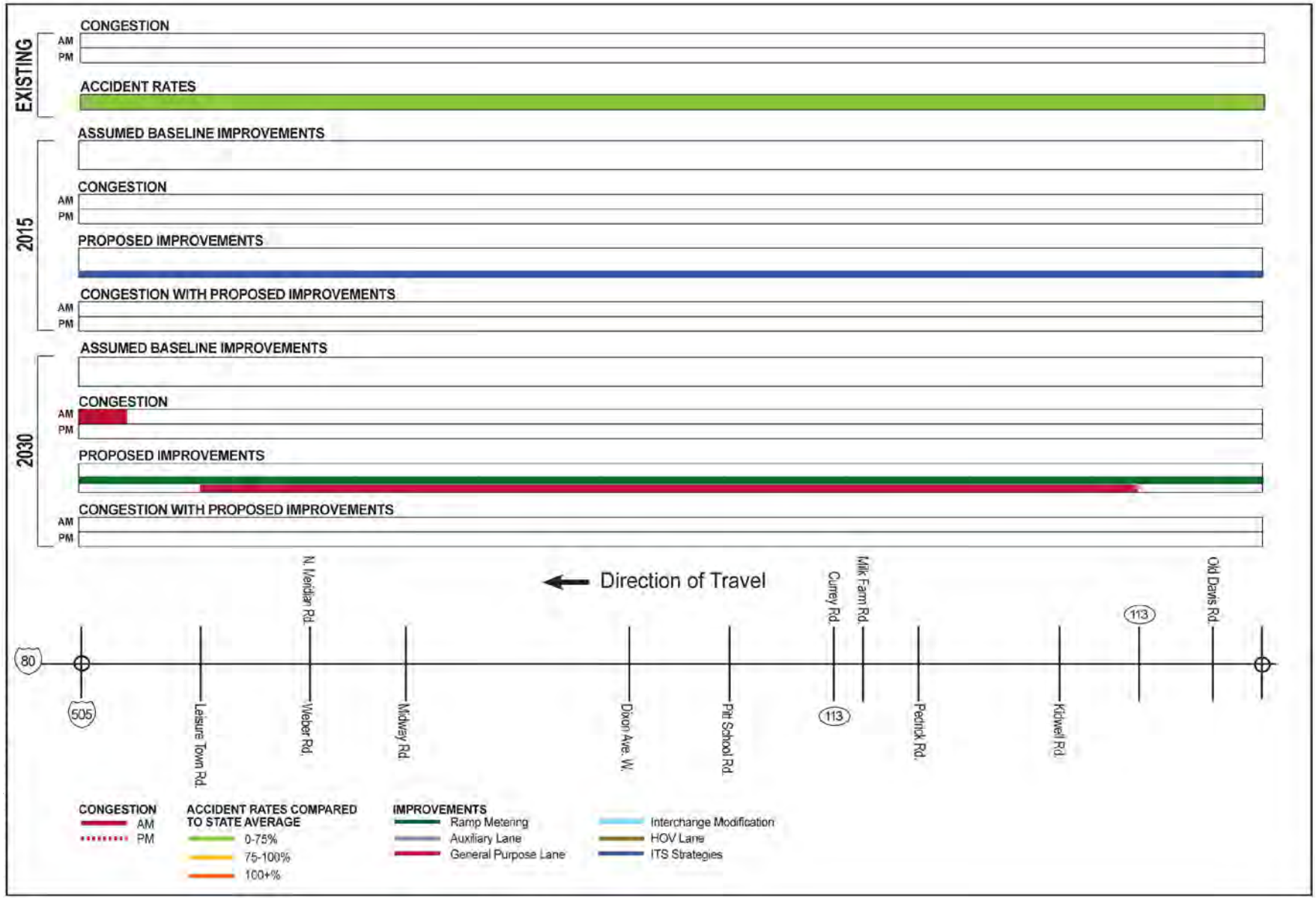


Exhibit 11: I-80 Westbound the County Line and I-505

3.6 I-680 corridor

3.6.1 Year 2015

3.6.1.1 Operating Conditions

For I-680, the 2015 analysis assumed completion of the improvements to the I-680 approach to the Benicia-Martinez Bridge. No other improvements to I-680 were assumed.

With this 2015 improvement, according to the I-680 FPI, there are no congested segments on I-680 during the 2015 AM peak, but four congested segments while during the PM peak. These congested locations are as follows:

- Northbound from the Lake Herman Road to Industrial Way
- Northbound from Parish Road to Morrow Lane
- Northbound from Gold Hill Road to Summerset Drive
- Northbound from the I-80 interchange to between Cordelia Road and Gold Hill Road

Within these four northbound locations, four bottlenecks occur and are addressed as part of the overall operational improvement strategy. These bottlenecks are listed in Exhibit 12.

Exhibit 12: 2015 I-680 Bottleneck Locations

No	Location	Details
1	Northbound between the Lake Herman Road on-ramp and Parish Road off-ramp	This bottleneck occurs where the Lake Herman Road on-ramp traffic joins with the two northbound general purpose lanes at this location.
2	Northbound between the Parish Road on-ramp and Marshview Road off-ramp	This bottleneck occurs where the Parish Road on-ramp traffic joins with the two northbound general purpose lanes at this location.
3	Northbound between the Marshview Road on-ramp and Goldhill Road off-ramp	This bottleneck occurs where the Marshview Road on-ramp traffic joins with the two northbound general purpose lanes at this location.
4	Northbound at the I-80 junction	This bottleneck occurs just south of the I-80 interchange due to the capacity constraint at the merge onto I-80.

3.6.1.2 Operational Improvement Strategies

The operational improvement strategies recommended for addressing the projected 2015 deficiencies along on I-680 are detailed in Exhibit 13.

Exhibit 13: 2015 I-680 Operational Improvement Strategies

Strategy	Location and Details
HOV Lane	Extend the northbound HOV lane through Solano County to the I-80 interchange.
	Provide an HOV lane connector from I-680 northbound to I-80 eastbound
Ramp Metering	Ramp metering on all NB on-ramps. Where practical, add additional storage and/or through lanes to maximize the efficiency of ramp meters.

Exhibit 13: 2015 I-680 Operational Improvement Strategies	
Strategy	**Location and Details**
ITS	Extend coverage and fill gaps as needed between the Benicia-Martinez Bridge and the I-80 junction

3.6.2 Year 2030

3.6.2.1 Operating Conditions

While the 2030 analysis conducted as part of the I-680 North FPI study has not yet been approved by MTC, that analysis has been used in this report as the basis for defining forecasted conditions and mitigation strategies on I-680 for the Year 2030.

Similar to the 2015 operating conditions, the I-680 2030 analysis assumed completion of the improvements to the I-680 approach to the Benicia-Martinez Bridge. The 2030 analysis also assumed improvements at the I-80/I-680 junction, including a higher-capacity connector from northbound I-680 to eastbound I-80. The improvements at this junctions are expected to relieve the bottleneck at this location as previously described under the year 2015 conditions.

With these improvements, it is projected that there will be two congested segments in the southbound direction along I-680 during the 2030 AM peak hour, and three congested segments in the northbound direction during the PM peak hour.

AM Peak:

- Southbound from south of the Stone Valley Road interchange in Contra Costa County to north of the Parish Road interchange in Solano County
- Southbound from the Marshville Road interchange to the I-80 interchange

PM Peak:

- Northbound from the Lake Herman Road interchange in Solano County to the Alcosta Boulevard interchange at the southern end of Contra Costa County
- Northbound from the Parish Road interchange to the Lake Herman Road interchange
- Northbound from the Gold Hill Road interchange to the Marshville Road interchange

These bottlenecks associated with these congested locations are listed in Exhibit 14.

Exhibit 14: 2030 I-680 Bottleneck Locations		
No	**Location**	**Details**
1	Southbound south of the Stone Valley Road interchange in Contra Costa County	This bottleneck occurs where the Stone Valley Road on-ramp traffic joins with the three southbound general purpose lanes and one HOV lane at this location.
2	Southbound at the Marshview Road interchange	This bottleneck occurs where the Marshview Road on-ramp traffic joins with the two southbound general purpose lanes at this location.
3	Northbound between the Lake Herman Road on-ramp and Parish Road off-ramp	This bottleneck occurs where the Lake Herman Road on-ramp traffic joins with the two northbound general purpose lanes at this location
4	Northbound between the Parish Road on-	This bottleneck occurs where the Parish Road on-ramp traffic

Exhibit 14: 2030 I-680 Bottleneck Locations		
No	**Location**	**Details**
	ramp and Marshview Road off-ramp	joins with the two northbound general purpose lanes at this location.
5	Northbound between the Gold Hill Road on-ramp and Cordelia Road off-ramp	This bottleneck occurs where the Gold Hill on-ramp traffic joins with the two northbound general purpose lanes at this location.

3.6.2.2 Operational Improvement Strategies

The operational improvement strategies proposed for 2015 are expected to address four of the five bottlenecks listed above. The lone location not addressed is that at Stone Valley Road in Contra Costa County. Because of the severity of the congestion associated with this bottleneck and the impact to travel within Solano County, a strategy to address this bottleneck has been identified and is listed in Exhibit 15.

Exhibit 15: 2030 I-680 Operational Improvement Strategies	
Strategy	**Location and Details**
HOV Lane	Extend the southbound HOV lane from North Main Street to Livorna Road to fill in the HOV gap (This improvement is in Contra Costa County, but would alleviate congestion in Solano County.)
	Ramp metering on all SB on-ramps. Where practical, add additional storage and/or through lanes to maximize the efficiency of ramp meters.

3.6.3 Summary

Exhibits 16 and 17 summarize the existing, 2015, and 2030 conditions and the suggested operational improvements for congested segments and bottleneck locations. The proposed operational improvements would fully alleviate all of the respective 2015 and 2030 congestion. 2015 operational improvements include ramp metering and HOV lanes while 2030 improvements only include HOV lanes.

It should be noted that while these exhibits do not show the deployment of ITS elements along the I-680 corridor, installation of ITS elements, including the necessary communication system, to fill gaps and cover the entire corridor is recommended as an operational improvement strategy for 2015.

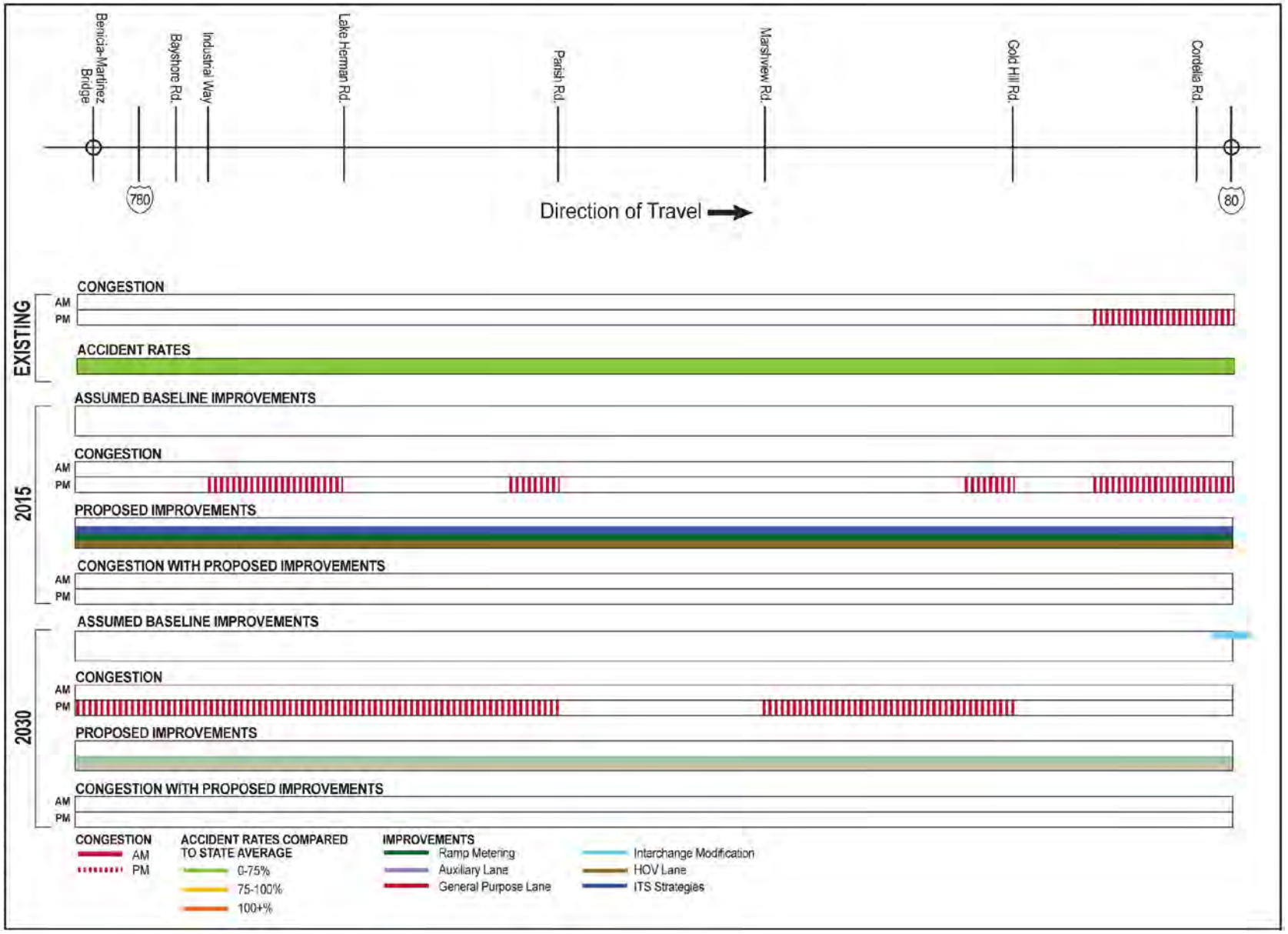


Exhibit 16: I-680 Northbound between the Benicia Bridge and I-80

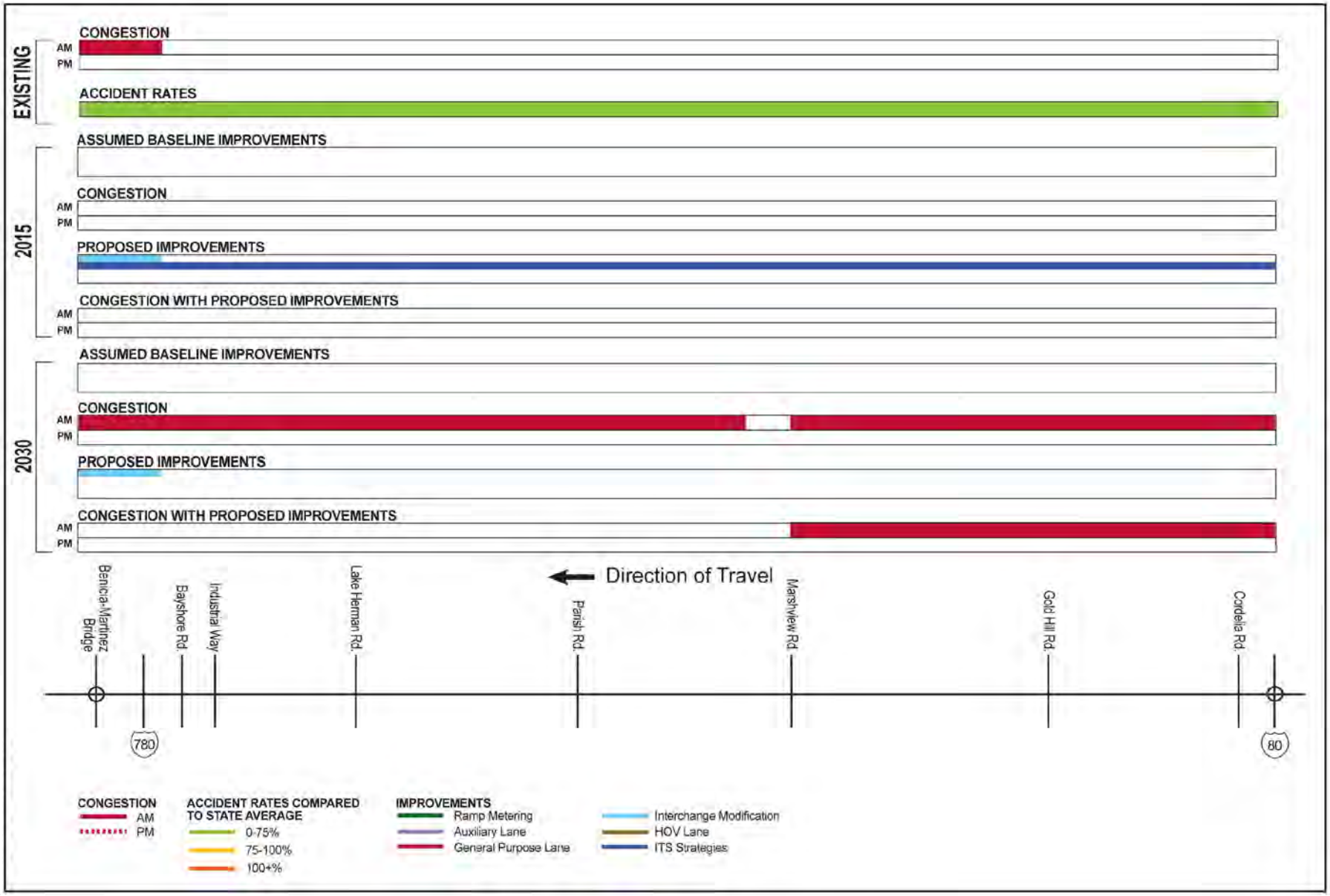


Exhibit 17: I-680 Southbound between I-80 and the Benicia Bridge

3.7 I-780 corridor

3.7.1 Year 2015

3.7.1.1 Operating Conditions

The completion of the improvements to the I-780 approach to the Benicia-Martinez Bridge has been included for the 2015 I-780 analysis. As mentioned in the Performance Degradation Report and detailed in the I-780 FREQ model, no congested segments occur during either peak hour in the year 2015.

3.7.2 Year 2030

3.7.2.1 Operating Conditions

Similar to the 2015 operating conditions, the completion of the improvements to the I-780 approach to the Benicia-Martinez Bridge has been included for the 2030 I-780 analysis.

As mentioned in the Performance Degradation Report and detailed in the I-780 FREQ, two congested segments would occur during the AM peak hour while two congested segments would also occur during the PM peak hour.

AM Peak:

- Eastbound between East 5th Street and East 2nd Street
- Westbound between the Cedar Street on-ramp to the Columbus Parkway on-ramp

PM Peak:

- Eastbound between the Columbus Parkway on-ramp to east of the Glen Cove Road on-ramp
- Eastbound between the Spruce Street on-ramp to the off-ramp to eastbound I-80

In addition to the controlling bottlenecks at the downstream end of these segments, the analysis also revealed an embedded bottleneck in the westbound direction between the Glen Cove Road on-ramp and Cedar Street off-ramp. The controlling and embedded bottlenecks and their causes are listed in Exhibit 18.

Exhibit 18: 2030 I-780 Bottleneck Locations		
No	**Location**	**Details**
1	Eastbound between the East 5th Street on-ramp and the exit to NB I-680	This bottleneck occurs when high eastbound volumes in the two general purpose lanes combine with the East 5th Street on-ramp traffic.
2	Westbound between Cedar Street on-ramp and I-80	This bottleneck occurs where the Cedar Street on-ramp traffic joins with the two westbound general purpose lanes at this location.
3	Westbound between Glen Cove Road on-ramp and Cedar Street off-ramp	This bottleneck occurs where the Glen Cove Road on-ramp traffic joins with the two westbound general purpose lanes at this location.
4	Eastbound between Columbus Parkway on-ramp and Military Way off-ramp	This bottleneck occurs when high eastbound volumes in the two general purpose lanes combine with the Columbus Parkway on-ramp traffic at this location.
5	Eastbound between Spruce Street on-ramp and Glen Cove off-ramp	This bottleneck occurs where the Spruce Street on-ramp traffic joins with the two eastbound general purpose lanes at this location.

3.7.2.2 Operational Improvement Strategies

The operational improvement strategies recommended for addressing the projected deficiencies along on I-780 are detailed in Exhibit 19. It is expected that as traffic demand along the I-780 corridor grows, ramp metering can be used to address the emerging bottlenecks. However, once demand reaches the levels projected for 2030, the combination of ramp metering and proposed auxiliary lanes will be needed to alleviate congestion. The effectiveness of these two combined strategies is discussed in the next section. By 2030, it is also recommended that ITS coverage be extended throughout the segment of I-780 from I-80 to I-680.

Exhibit 19: 2030 I-780 Operational Improvement Strategies	
Strategy	**Location and Details**
Ramp Metering	Install ramp metering at local access interchanges in the eastbound and westbound directions between I-80 and I-680
General Purpose Lane	Provide a third westbound general purpose lane between the Glen Cove Road on-ramp and the Cedar Street on-ramp. The third lane should connect with the Cedar Street on-ramp.
Auxiliary Lane	Provide an eastbound auxiliary lane between Spruce Street and Glen Cove Road
	Provide an eastbound auxiliary lane between Columbus Parkway and Military Highway West
ITS	Extend coverage and fill gaps as needed between I-80 and I-680

3.7.3 Summary

The existing, 2015, and 2030 congestion conditions and suggested operational improvements are shown in Exhibits 20 and 21. Since there is no existing or 2015 congestion no operational improvements are suggested. The 2030 congestion is mostly alleviated with the suggested operational improvements. Even with the improvements, a segment of eastbound I-780 between East 5th Street and the I-680 interchange would remain congested in 2030.

It should be noted that while these exhibits do not show the deployment of ITS elements along the I-780 corridor, the installation of ITS elements is part of the prioritization of projects described in Chapter 5, Implementation Plan.

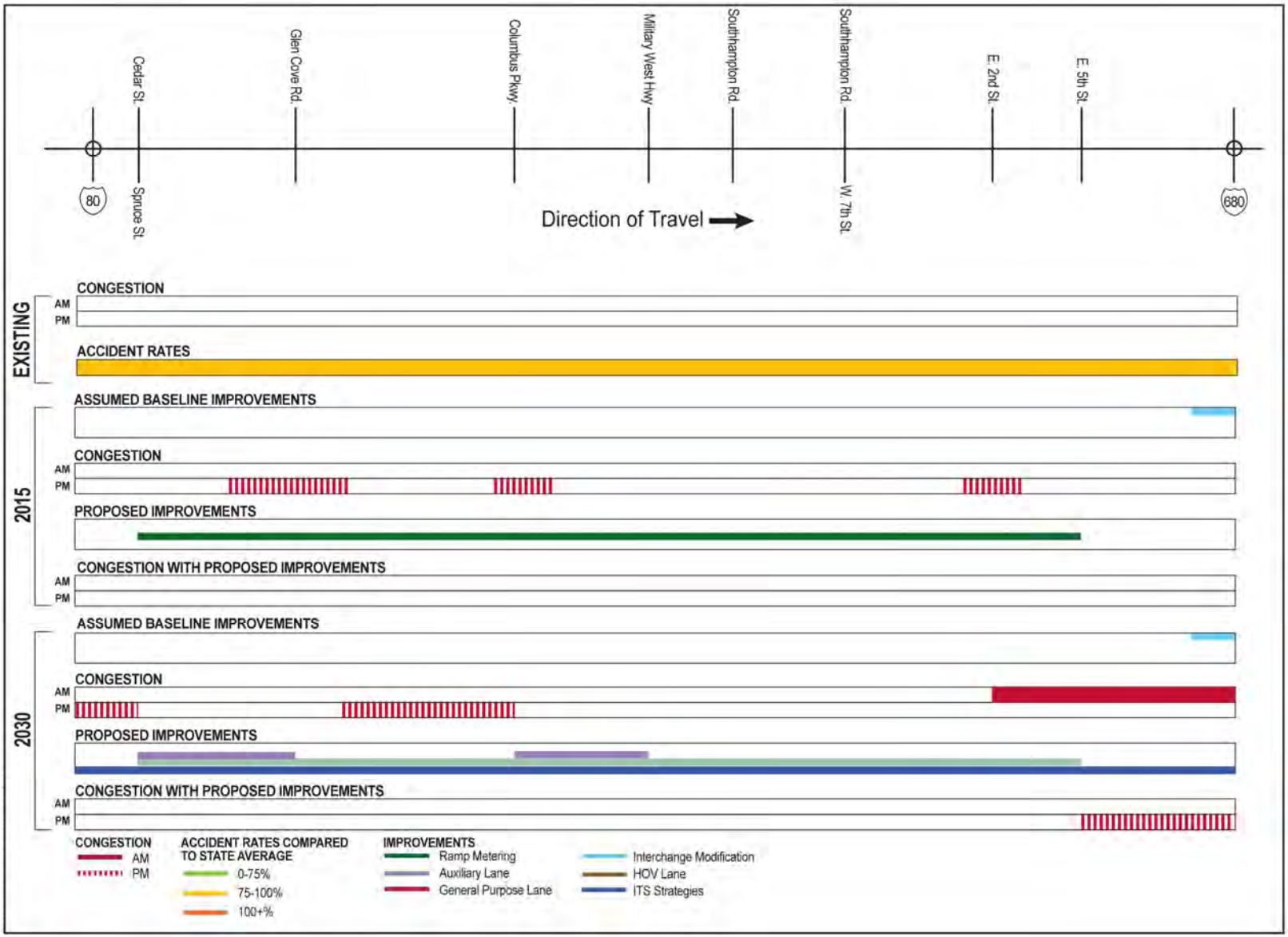


Exhibit 20: I-780 Eastbound between I-80 and I-680

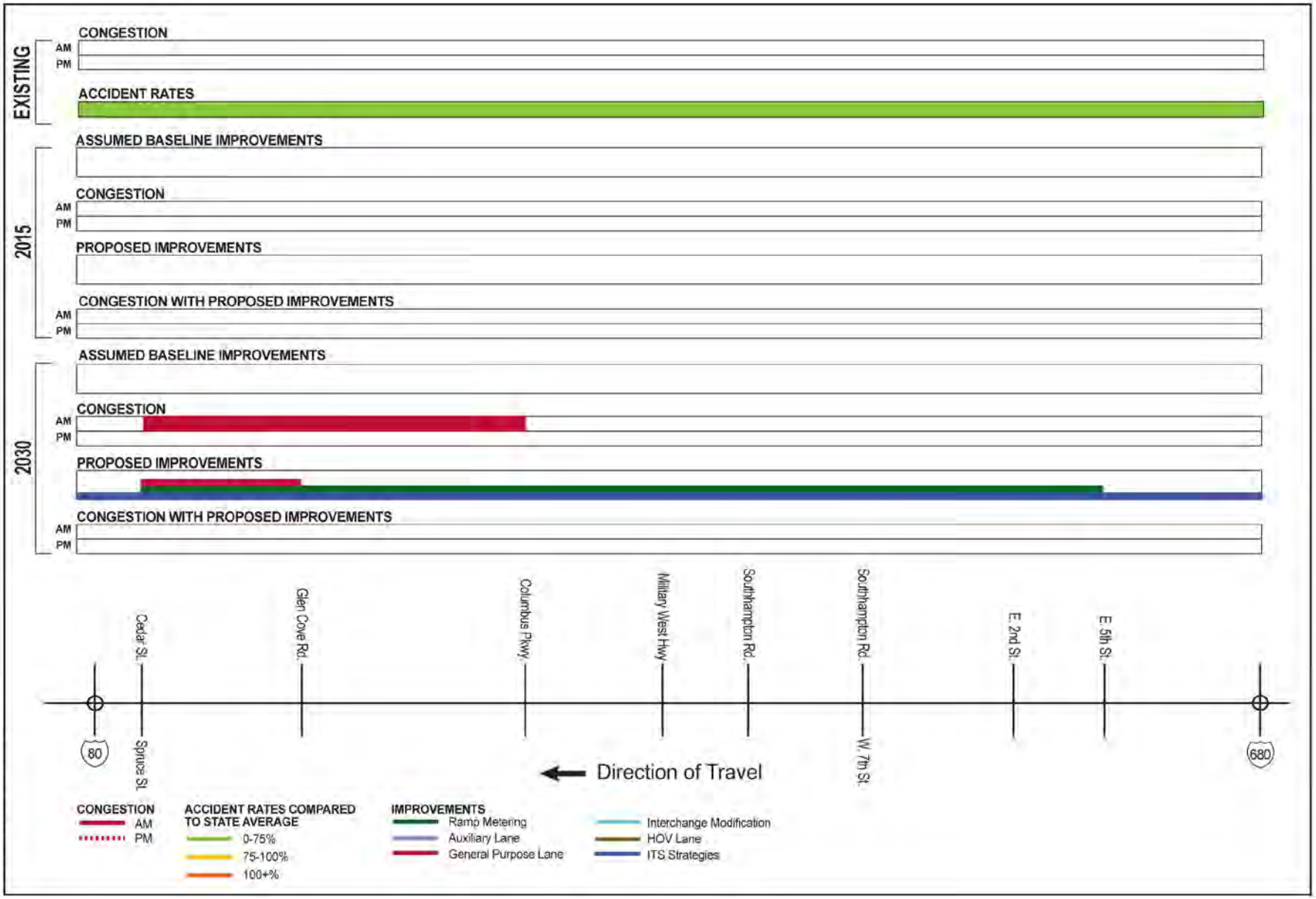


Exhibit 21: I-780 Westbound between I-680 and I-80

9. 4. ITS ARCHITECTURE AND IMPLEMENTATION PLAN

This section consists of a Corridor-Level ITS Architecture that provides recommendations for policies and agreements that are necessary to ensure that ITS deployments are incorporated into operational improvements programmed along the freeway corridors in Solano County. It will also provide guidance for design and deployment of ITS elements along the freeway corridors including any coordination and information sharing with the local cities, the County and the regional agencies as part of the Solano Highways Operations Study.

An ITS Architecture is defined by the US Department of Transportation as *"a common framework for planning, defining, and integrating intelligent transportation systems."* It is a blueprint or a plan of how ITS will be deployed, how it will interact with other systems, and how it functions and exchanges information.

4.1 Section Organization

This section is organized into the following primary sections:

- Section 2: Background – provides an overview of the project and the need for a corridor-level architecture
- Section 3: Corridor-Level Architecture – defines the architecture including both existing/planned components as well as future/recommended ITS elements and strategies.
- Section 4: Other Advanced ITS Strategies (Tier 2) – describes future ITS strategies that may be considered in the long-term.
- Section 5: Next Steps - Provides a brief summary of the next steps.
- Appendix A – Existing ITS Device Inventory – includes the current listing of ITS devices as reported by the TOS Implementation Plan and supplemented by the Freeway Performance Initiative Reports and additional research.
- Appendix B – Market Package Diagrams – tailored to the Corridor from the generic framework of the National Architecture to describe the interface requirements

4.2 Background

The I-80/I-680/I-780 Corridor-Level ITS Architecture builds on previously developed reference documents to develop a more specific picture of ITS deployment in the corridor. These reference documents provide background on other projects in the region and guidance from the Federal Highway Administration (FHWA) on the future of ITS integration. It is important for the I-80/I-680/I-780 ITS Architecture to provide continuity with past deployments but also to be consistent with future guidelines in order to provide flexibility for future procurements and revisions.

4.2.1 Conformance with Statewide and Bay Area Regional ITS Architectures

Statewide ITS Architecture and System Plan

The National ITS Architecture and Standards Conformance rule and policy (often referred to collectively as the Final Rule) require that projects funded with highway trust funds conform to the national architecture and standards, be guided by a regional architecture of geographic boundaries defined by stakeholder needs, and use a system engineering analysis that considers the total project life cycle.

The Statewide ITS Architecture and System Plan is a framework for identifying present and future information system integrations serving transportation that are *inter-regional, inter-jurisdictional* in nature. It is also a planning platform for future transportation information systems. The System Plan identifies high level operational concepts, necessary multi-party institutional agreements, stakeholders and system functional requirements. The California Statewide ITS Architecture and System Plan meets the requirements of the final rule for those services that are statewide and/or are state-level in nature for California.

Bay Area Regional ITS Architecture

FHWA's Final Rule requires major ITS projects to be in conformance with the Regional ITS Architecture. Thus, the I-80/680/780 Corridors are governed by the Bay Area Regional ITS Architecture, and any major ITS project within those corridors must be in conformance with the Bay Area Architecture. The following outlines how this Corridor-Level ITS Architecture is in conformance with the 2008 Bay Area Regional ITS Architecture:

- Stakeholders – All of the stakeholders in the Solano Highways Partnership are included as stakeholders in the Bay Area Regional ITS Architecture.

- Market Packages – Market packages are categories of ITS projects. In order to be in conformance, the I-80/I-680/I-780 Corridor-Level ITS Architecture must only be implementing projects that match the categories found in the Bay Area ITS Architecture. The following are the ITS project categories (identified by a standard 4-letter, 2-number code and title) that this corridor-level architecture will be implementing. All of these categories are identified in the Bay Area ITS Architecture.

    - ATMS04 – Freeway Control
    - ATMS01 – Network Surveillance
    - ATMS06 – Traffic Information Dissemination
    - ATMS08 – Traffic Incident Management
    - ATIS01- Broadcast Traveler Information

- Project – The I-680 Corridor is already included in the Bay Area ITS Architecture in one place:

    - The Bay Area ITS Architecture includes a "future" project called "I-680 Corridor Traffic Operations System Elements and Ramp Metering."

> The Bay Area ITS Architecture also includes a generic project that is used to provide a framework for the freeway control projects that are not identified by name. This "freeway control" project involves deploying TOS elements on the freeway and sending the data back to the Caltrans District 4 Transportation Management Center.

Based on this information, it is recommended that an update the Regional Architecture be processed to include the I-80 and I-780 Corridors similarly to the I-680 Corridor. This is to bring all three corridors closer to conformance with the Regional Architecture. However, it should be noted that based on the two projects already in the Regional Architecture, it is believed that the I-80/680/780 Corridors are in conformance with the Regional Architecture. The updates with the additional projects will serve to clearly define the conformance limits

FHWA's Interim Guidance on Information Sharing

For the I-80/680/780 Corridors ITS Architecture, the exchange of real-time information will be essential. Having up-to-date information on roadway conditions, especially during incidents and emergencies will be critical to providing traveler information and implementing management strategies.

To that effect, FHWA has issued an Interim Guidance on Information Sharing Specifications and Data Exchange Formats in response to SAFETEA-LU legislation that called for a Real-Time System Management Information Program to provide for the ability to monitor real-time travel conditions and provide that information to the general public. The Final Guidance is being developed based on comments received through February 2008.

The Final Guidance will clarify and provide additional information on the Interim Guidance, and will eventually become recommended as a final rule. The Interim Guidance focused on the center-to-center data exchange of real-time congestion and incident information between agencies. The Real Time Information Program (RTIP) addresses interoperability of systems and standardized data exchange. It does not address the scope or type of data collection or control of field equipment or data. The guidance focuses on the creation of statewide data exchange standards for interoperability between different types of agencies – transit, traffic, and emergency service providers – and information service providers. The Interim Guidance does acknowledge that over time existing systems will need to be migrated to the system, and new systems should use the statewide standards. The Interim Guidance provides data standards for each of the functions of the RTIP.

Although the FHWA Interim Guidance is not finalized, it is important to keep its ultimate message in mind for the I-80/I-680/I-780 Architecture. This Architecture provides a framework for a center-to-center data exchange to the Caltrans TMC and the MTC center-to-center network using adopted data exchange standards consistent with the Interim Guidance and the National ITS Architecture.

Caltrans Traffic Operations System (TOS) Implementation Plan

The Caltrans Traffic Operation System Implementation Plan is a long-term plan for the implementation of TOS elements and communications throughout the Bay Area. It provides details on types of equipment, existing and proposed communications, and functional requirements. It is important for the Corridor-Level ITS Architecture to be consistent with the functional requirements

used in the TOS Implementation Plan and to use standard Caltrans field equipment within Caltrans right of way. This Corridor-Level ITS Architecture was developed in close coordination with the TOS Implementation Plan.

MTC Freeway Performance Initiative (FPI)

MTC's Freeway Performance Initiative is an area-wide assessment of the freeway conditions in terms of congestion – existing levels of congestion, possible causes, and future impacts. This Corridor-Level ITS Architecture combined with the subsequent Implementation Plan will facilitate the deployment of ITS elements identified and recommended under the FPI studies prepared for I-80 and I-680 corridors. Moreover, under this Solano Highways Operations Study, an operational analysis is being conducted along I-780, which will include recommendations for operational improvements to improve congestion. The ITS deployments recommended as part of this Architecture combined with the operational improvements will provide the tools necessary for system management of the three corridors.

Bay Area 511 System

The Bay Area's 511 Traveler Information Program is a partnership among MTC, Caltrans, the California Highway Patrol, and many of the region's transit and paratransit operators. The program provides traffic, transit, rideshare and bicycling information to the public by telephone via the federally dedicated information phone number (511) and on a website at 511.org. For the traffic information, the 511 program utilizes freeway sensors as well as toll tag readers installed along the major freeways to generate information including congestion levels and travel times. The 511 Program is considered the one stop source for traveler information including freeway congestion levels, incident reporting and transit planning. Thus, it is anticipated that the 511 Program will continue to be the primary data disseminator for the Solano Highways.

4.2.2 Corridor-Level ITS Architecture

This Corridor-Level ITS Architecture includes both existing and planned components, as well as future and recommended components. The existing and planned components reflect those components that are already being programmed or planned for in previously documented efforts. The future and recommended category represents recommendations being made as a part of this Corridor-Level ITS Architecture and Implementation Plan development effort in order to fill in gaps in the existing system in relation to needs.

This Corridor-Level ITS Architecture, in accordance with federal guidelines, is technology-neutral and focuses on connectivity between and among systems and system components, in order to provide a basis for connectivity, thereby maximizing the technology and communications investments made. Specific field element locations will be outlined in a subsequent task in the Implementation Plan.

Existing Traffic Operations System (TOS)

The existing TOS elements on I-80, 680, and 780 consist of CCTV cameras, changeable message signs (CMS), extinguishable message signs (EMS), highway advisory radio (HAR), and traffic monitoring stations (TMS). The devices are owned and operated by Caltrans. Figure 4-1 illustrates a high-level diagram of the existing Traffic Operations System and the full inventory of existing ITS devices can be

found in Appendix A. Additionally, Figure 4-2 shows the approximate locations of the existing ITS devices along the three corridors.

CCTV Cameras

The CCTV cameras on I-80, I-680, and I-780 are standard Caltrans analog cameras with remote pan, tilt, and zoom control. The cameras are used to monitor road conditions and verify incidents. Caltrans is moving towards having camera images available to the public on their website. However, none of the images currently online are from cameras in Solano County. The standard camera deployment is at 1-mile intervals. This allows the Caltrans operators to see all areas of the freeway. Currently, there is one camera on I-780. The cameras on I-680 are spaced at approximately 1-mile intervals, and the cameras on I-80 are spaced at 1-mile intervals with two 1-mile gaps.

Message Signs

There are currently eight changeable message signs within the study area – one on I-780, two on I-680, and four on I-80. The signs are used to display travel times, warn travelers about incidents, and advise them on changes to roadway conditions. When not in use, signs are left blank. They are standard Caltrans Model 500 signs. Caltrans also has extinguishable message signs that are activated simultaneously by the Highway Advisory Radio (HAR) system when an HAR message is recorded and the operator initiates the HAR transmissions over the air.

Highway Advisory Radio

Highway Advisory Radio (HAR) is used to transmit messages over the radio concerning road and travel conditions. They provide more detail about incidents or congestion than can be displayed on changeable message signs. An extinguishable message sign displays a message that instructs travelers to turn to station 840 AM. If there is no message, the HAR is silent. The HAR consists of an omni-directional antenna on a pole positioned to avoid overlapping signals. There are two HAR on I-680 and one on I-80.

Detection

Vehicle detection is used to continuously monitor the flow of traffic on the freeway. Typically, detection (also known as traffic monitoring stations or TMS) is installed at quarter mile spacing to measure volume and speed to determine the extent of congestion or the impact of an incident. The detector reports back to the Transportation Management Center every 20 to 30 seconds. When collected and interpreted it can enable real-time traffic information to be disseminated to the public. The information collected is archived for system management planning purposes.

Most of the detectors are inductive loop detectors. I-80 has detection installed approximately every half mile, which is supplemented by wireless detection. I-780 has detection in two locations, and I-680 has detection at half-mile to one mile intervals with a few exceptions.

Communication Infrastructure

These devices in the study area are connected to the TMC using a variety of different communications media. The CCTV, CMS, and HAR are connected typically via land lines. The land lines include a combination of Digital Subscriber Line, Integrated Services Digital Network, and Plain

Old Telephone Service. The TMS use wireless General Packet Radio Service communications. Some of the CMS use wireless communications in addition to the land lines. Provided below are brief descriptions of some of the leased communications technologies employed by ITS systems in the Bay Area.

Integrated Services Digital Network (ISDN)

Integrated Services Digital Network (ISDN) is a form-up of dial-up communication used primarily for CCTV cameras. The data exchange rate is typically 112 kilobits per second (kbps) with rates up to 384 kbps depending on the service agreements with the ISDN provide. The video images from the cameras are digitized and compressed using the standard MPEG encoding formats.

Digital Subscriber Line (DSL)

Digital Subscriber Line (DSL) is a medium bandwidth digital communications technology using existing telephone lines. Depending on the flavor of DSL, the data exchange rate can reach up several megabits per second (Mbps) in one direction. However, the actual rate is dependent on the provider, the quality of the telephone lines and the proximity to the provider's central office. DSL is appropriate for medium speed data transfer and moderate quality video. The Bay Area Video Upgrade (BAVU) project is testing the use of DSL for communications with freeway CCTV cameras.

Plain Old Telephone Service (POTS)

Plain Old Telephone Service (POTS) is a dial-up phone connection to the field equipment. The connection is not always "on," it must be dialed and the connection must be established, which takes time. POTS is not suitable for video exchange and is currently used for center to field communications between the central system and the field masters.

General Packet Radio Service (GPRS)

General Packet Radio Service (GPRS) is a form of leased wireless communications used for some changeable message signs and is anticipated for the new forms of vehicle sensors being deployed on the major freeways.

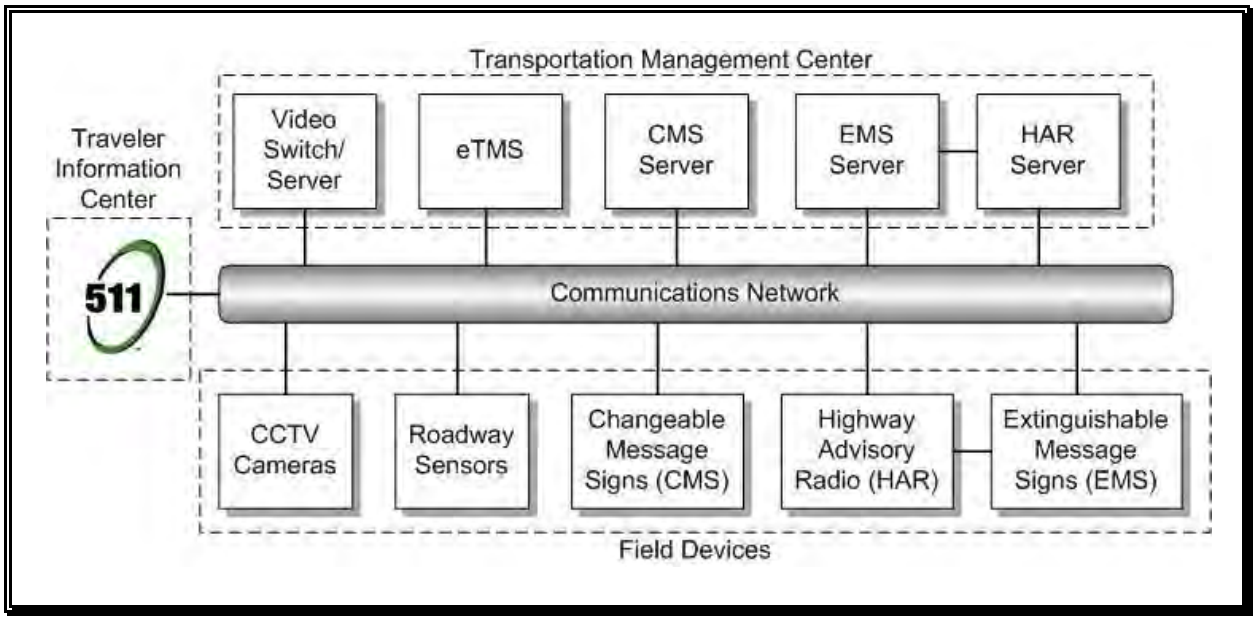


Figure 4-1: High Level TOS Diagram - Existing

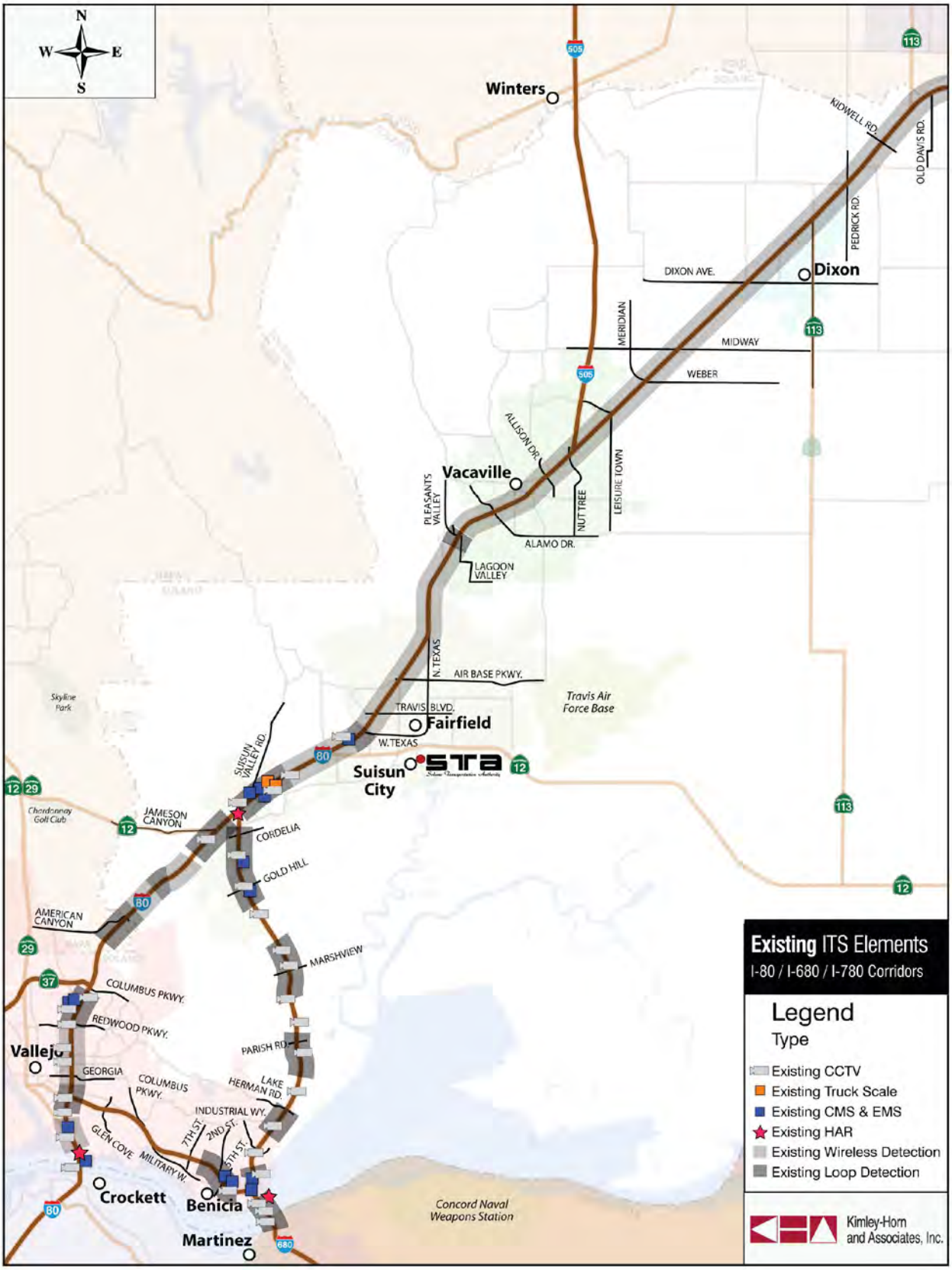


Figure 4-2: Existing ITS Elements

Stakeholders

The Solano Highways Partnership is made of the following partners with the roles and responsibilities explained below. These agencies are working together to implement the system discussed in this Corridor-level Architecture. Table 4-1 provides a high level summary of the Partnerships roles and responsibilities.

Table 4-1: - Stakeholder Roles and Responsibilities

Stakeholder	Roles and Responsibilities
City of Benicia	Operates and maintains arterials within its jurisdiction
City of Dixon	Operates and maintains arterials within its jurisdiction
City of Fairfield	Operates and maintains arterials within its jurisdiction
City of Vacaville	Operates and maintains arterials within its jurisdiction
City of Vallejo	Operates and maintains arterials within its jurisdiction
County of Solano	Operates and maintains arterials within its jurisdiction.
MTC	Metropolitan Planning Organization (MPO) of the San Francisco Bay Area. Maintains the Regional ITS Architecture, distributes transportation funds; operates and maintains 511, the regional ATIS, and the regional center-to-center data sharing network (currently in development)
SACOG	Regional agency for Sacramento area. Provides input on continuity across jurisdiction boundaries.
Caltrans District 4	Operates and maintains I-80, I-680, and I-780 including ITS elements. Provides input on continuity across jurisdiction boundaries into District 3.
Caltrans District 3	Operates and maintains freeways within District 3. Provides input on continuity across jurisdiction boundaries into District 4.

There are situations where Caltrans owns, operates and maintains the traffic signals at the interchange ramp intersections and the local city pays for the power to the traffic signals.

4.2.2.1 Operational Scenarios

The operational scenarios describe how the system will operate under different circumstances. These scenarios serve to describe the main functions of the stakeholders under the Concept of Operations. The operations of the equipment will be based on the following operational goals:

- Share traffic information between the agencies to improve coordination and management of traffic during normal operations
- Improve communications between the agencies during major freeway incidents.

The identification of these goals provides a basis for forming, maintaining, and sharing agreements between agencies in the region. These goals will allow the system to operate efficiently and to meet the needs of all of stakeholders. This section will begin to define system management activities and highlight potential issues to be addressed prior to system deployment in order to achieve these goals.

Described below are the operational scenarios for the Solano Highways. Table 4-2 also provides a summary of the operational concepts under each of the operational scenarios.

Operational Scenario - Normal Operations

During normal operations, each agency will operate its respective system components, managing traffic on its own roadways. Caltrans will operate all equipment within their right of way from the Caltrans TMC in Oakland. Cities and surrounding jurisdictions will coordinate with TMC staff as appropriate to view specific camera angles or change message sign information. Ramp metering agreements between Caltrans and the Solano Highways Partners can be used to set metering hours, queue lengths, and metering rates to ensure that metered ramps do not negatively impact local streets. Additionally, consistent with other ramp meter implementations in the Bay Area (e.g., San Mateo County), Caltrans staff should work closely with the local agency's staff on the continuous monitoring and fine tuning of the ramp meters once deployed. While Caltrans will own and operate the ramp meters, the local cities and Caltrans should have a means to work together to adjust as necessary the ramp meter rates to minimize the impacts to the local streets.

Operational Scenario - Major Incidents

When an incident occurs, the California Highway Patrol (CHP) will assume the role of Incident Commander. CHP will communicate to Caltrans relative to actions that need to be taken to address the traffic impact. Caltrans may also identify incident information via CHP Computer Aided Dispatch (CAD). Caltrans will determine if it is a major or minor incident. If it is a major incident where more than 50% of the freeway lanes are blocked, the appropriate alternate route(s) will be implemented by Caltrans operators. This approach respects and utilizes the established process that is currently in place to manage incidents.

In response to major incidents, Caltrans will coordinate with the local cities and assume "control" of devices along the alternate routes affected by the incident should the routes be on local arterials in order to move a large amount of diverted freeway traffic around the incident and back to the freeway as quickly as possible. While this is not currently the practice at Caltrans, there are developing Smart Corridors that may implement some form on control by Caltrans over local arterial devices. This type of control will require cooperation and agreements between the Partnership stakeholders.

This alternate route strategy addresses traffic immediately upstream of the incident location. Activation of adjacent (upstream) alternate routes may be necessary based on the severity of the freeway traffic congestion and time of day. Concurrently, Caltrans may also divert freeway traffic at the freeway interchange(s) upstream of the incident location to relieve congestion if the incident is very severe.

Caltrans, in coordination with local cities, will also be the agency that controls the activation and deactivation of the alternate route devices. Upon clearance of the incident as indicated by CHP or upon a determination by Caltrans that arterial volumes no longer require the incident response plans, the associated ITS equipment will revert to normal operations and local agencies will again be responsible for active management.

Operational Scenario – Emergency Response

When an emergency situation occurs, the California Highway Patrol (CHP) will assume the role of Emergency Response Commander. The CHP will communicate to the various emergency response stakeholders including Caltrans, MTC, Local Fire Departments, Emergency Operations Centers, the Department of Homeland Security and the media relative to actions that need to be taken to address the transportation and security impacts and to disseminate the information n to the public. Caltrans may also identify incident information via CHP Computer Aided Dispatch (CAD).

The CHP will determine the extent of the emergency operations and work with the emergency response personnel to implement the emergency response plans and track the progress. Depending on the extent of the emergency situation, entire freeway lanes may be blocked and used as evacuation routes in the reverse direction. In such cases, the appropriate alternate and bypass route(s) will be implemented by Caltrans operators and directed by CHP personnel. This approach respects and utilizes the established process that is currently in place to manage incidents.

In response to emergency situations including an evacuation scenario, Caltrans and the CHP will assume "control" of traffic control devices along the alternate, bypass and evacuation routes. The goal of controlling the devices is to addresses traffic upstream and around the emergency location and to divert traffic away from the emergency location. Activation of adjacent (upstream) alternate routes may be necessary based on the severity of the emergency and time of day. Concurrently, Caltrans may also divert freeway traffic at the freeway interchange(s) upstream of the incident location to relieve congestion and support the evacuation routes as appropriate.

The CHP and Caltrans, in coordination with local cities, will also be the agency that controls the activation and deactivation of the alternate, bypass and evacuation route devices. Upon clearance of the emergency situation as directed by the CHP, the associated devices will revert to normal operations and local agencies will again be responsible for active management.

Operational Scenario – Video Sharing and Control

The video images from CCTV cameras located within the project should be accessible to any jurisdiction or agency throughout the corridor in accordance with Caltrans and local jurisdictional policies. It should be noted that the Bay Area Video Upgrade (BAVU) and Center-to-Center Project is moving towards a system to share video between agencies and that this network may eventually be used. Caltrans has restrictions on video access during certain freeway events and will remove access to cameras during these events.

While it is technically possible to record video and archive video from these cameras, the initial policy will be to limit recording. A cooperative agreement between all agencies will be drafted to outline any video recording policy prior to implementing any video recording and archiving. Video recording will be limited to cameras outside of the state right of way in accordance with Caltrans policy.

Caltrans will have the ability to control the cameras (pan/tilt/zoom capability). Local agencies will coordinate with Caltrans TMC operators to view a specific camera angle. This functionality will include individual agency-definable security on a per camera, per agency, and per person basis to allow an agency to define which cameras are available to which users and which pre-set views (if any). It is not Caltrans current practice to share video with local agencies. However, the sharing of

video is being discussed as part of the I-80 ICM project and could potentially carry through into Solano County.

With viewing ability of cameras and camera images by multiple agencies, there is a need to clearly define "reuse" or "redistribution" guidelines. This would apply to the distribution of video to the media and/or general public either through direct feeds or through a web site. Clearly defined guidelines will be included in the interagency operating agreement that address this issue from the perspective of all involved stakeholders and CCTV camera owners in the corridor. At locations where privacy may be an issue (e.g., in the vicinity of residential development), care will need to be taken to create the privacy zones where the view is blacked out or inaccessible.

Operational Scenario - Future

As other advanced ITS strategies (hereinafter referred to as 'Tier 2') become implemented, additional operational scenarios will need to be defined. These ITS strategies are discussed further in Section 4. These functions will require more active operations and many of them will be a change from current operating procedures. They will require more frequent communication between agencies and more frequent monitoring of devices. These scenarios will be detailed as future Tier 2 projects are developed.

Table 4-2: Operational Concepts

Operating Scenario	Involved Stakeholders	Operational Concept
Normal Operations	Local cities, Caltrans	Each agency should commit to active operation of the ITS tools within their jurisdiction. This includes monitoring data collection devices and video cameras, and providing information to travelers. Agencies should commit to share information through a center-to-center connection through the Caltrans TMC. Each agency will also commit to maintain the equipment in their jurisdiction per the Maintenance agreement. All agencies will have the ability to view pre-set camera images. Control of devices will be determined by the owning agency, with all agencies having the ability to take control with permission of the owning agency.
Incident Management	Local cities, Caltrans, CHP	Local cities should commit to take appropriate action during incidents, adjusting the operations of the system to the extent possible including adjusting signal timing and providing detour routes, and providing information to travelers. The agency who identifies the incident will notify CHP. CHP determines the severity of the incident. CHP invokes standard operating procedures for incident clearance. If the freeway needs to be closed, CHP and Caltrans decide with the local agency what the alternate route will be. Caltrans monitors freeway CCTV and alerts travelers via CMS.
Emergency Response	Local cities, Caltrans, CHP, Homeland Security, Local fire departments, Emergency Operations	The CHP assumes the role of Emergency Response Commander and communicates with the various emergency response stakeholders to implement the emergency response plans and tracks the progress. In response to emergency situations including an evacuation scenario, Caltrans and the CHP will assume "control" of traffic control devices along all alternate, bypass and evacuation routes. Depending on the extent of the emergency situation, entire

Table 4-2: Operational Concepts		
Operating Scenario	**Involved Stakeholders**	**Operational Concept**
	Centers, media	freeway lanes may be blocked and used as evacuation routes in the reverse direction. In such cases, the appropriate alternate and bypass route(s) will be implemented by Caltrans operators and directed by CHP personnel.
Maintenance	Local cities and Caltrans	Agencies will maintain all equipment installed on the freeways with the exception of any stipulations per maintenance agreements, e.g., tool tag readers.
Video Operations	Local cities and Caltrans	Cameras on Caltrans right of way will not support recording images per standard Caltrans protocol. The Bay Area Center-to-Center project (BAVU) is defining a system to share video between local agencies. The system may move to this operational concept once it is developed. Agencies will be able to view pre-set views of cameras. The owning agency can define security restrictions on cameras if necessary. Priority for control will be determined by the owning agency based on the MOU. Video will be available to the public through the internet. Images from the freeway will follow standard Caltrans privacy protocol.

Maintenance

The maintenance responsibilities within the Solano County Highways will be consistent with standard operating procedures. Local cities within the corridors will continue to own, operate and maintain their equipment within their right-of-way and Caltrans will continue to own, operate and maintain all equipment within their right of way. The maintenance of the elements of the program will be as needed including routine maintenance, repairs and equipment replacements. It is assumed that all freeway elements will be operated and maintained by Caltrans. The maintenance procedures and prioritization of responses for troubleshooting of ITS field devices and systems will be established by the Partnership based on prior experience.

Continual maintenance of the system devices will ensure effective, optimal, and uninterrupted operation of the equipment. Maintenance equipment and procedures should be stored in central places to ensure that they can be appropriately used to monitor performance of the system. This information is necessary to identify trends in maintenance needs and to plan and forecast maintenance requirements and expenses.

Maintenance includes both field procedures used to restore device operation and shop procedures used to repair and test the malfunctioning equipment. Response procedures should be developed for normal operating circumstances, and to address unusual situations such as malfunctions, which may occur during periods when staff are not readily available. This includes the monitoring of the ITS devices for operational status and corrective actions taken for troubleshooting.

The costs of maintenance will be refined as the project planning and design progresses. These costs will include communication costs, repairing broken or damaged equipment, routine inspection and testing of devices, and cleaning of camera lenses. The operations and maintenance cost per device is

estimated below. These costs are estimated from FHWA's Cost Database. They include labor and equipment costs.

- CCTV Camera - $250/year/device
- CMS - $6000/year/device
- HAR - $250/year/device

As the functionality of the equipment is further utilized for the Tier 2 objectives, maintenance will be of primary importance because the devices must be fully functional to be used for adaptive ramp metering and active traffic management.

It should be noted that the I-80 Innovative Corridor Mobility (ICM) Project in Alameda and Contra Costa County is planning to implement system wide responsive ramp metering (adaptive ramp metering) and active traffic management strategies. It is anticipated that lessons learned from this project including implementation, operations and maintenance activities will be applied to the Solano County Highways.

List of Agreements

In order to implement, operate, and maintain a multi-function system with a center-to-center network and multiple stakeholders, agreements should be in place to guide decisions and clearly outline responsibilities. In addition to the current MOU that is in place between Caltrans, CHP, and MTC for 511 and data exchange, further agreements may be needed depending on the level of information exchange and the privileges preferred by the local agencies. As an example, no agreement would be necessary for a one-way video feed from Caltrans to a local agency unless the local agency wants a minimum level of reliability that the video feed will available (i.e., uptime), or if the local agency wants any form of control of the video feed. These agreements will assist in managing information, video and data exchange, operating procedures under various scenarios, and maintenance responsibilities and requirements. Table 4-3 provides a listing of some of the existing and potential agreements identified under the Regional Architecture.

Table 4-3: Stakeholder Agreements

Name of Agreement	Purpose	Stakeholders	Status
Memorandum of Understanding	Information exchange for incidents and 511. Details roles, responsibilities of Freeway Service Patrol	Caltrans, CHP, MTC	Existing
Memorandum of Understanding – Ramp Metering	To provide for analysis, approval, monitoring and fine tuning of the ramp metering rates	Solano Highways Partnership	Future [1]
Memorandum of Understanding – Video and Data Exchange	Video and data exchange along Solano County freeways.	Solano Highways Partnership	Future, if necessary
Memorandum of Understanding - Incident Management	Coordinate emergency response and incident information to the public. Identify and disseminate information on alternate routes. Provide traffic management during incidents on freeways and local routes.	Solano Highways Partnership	Future

1. The MOU would form the agreement between the partners to allow ramp metering to be implemented and managed. The details of the operation of the ramp meters will be determined through as needed detailed studies prior to turning on ramp metering.

Functional and Interface Requirements

Functional and interface requirements describe the capabilities and functions that a system and connections between systems and system components in order to accommodate an identified need.

In the context of this Corridor-Level ITS Architecture, functional requirements are a high-level description of the functions (or activities) of systems (also called elements) used to provide ITS services (market packages). Interface requirements, likewise, define the connectivity required between, among, and within systems. These requirements are developed for two purposes:

- To provide an input to the development of interfaces and information flows of the architecture; and

- To provide a potential resource for project deployers in defining functional requirements for the systems that may be developed or upgraded to provide state-level or interregional ITS services.

In the context of this project, this list of requirements describes the functions needed by the existing and planned systems (or elements) of the architecture to provide current services. The architecture does not prescribe that future projects meet any or all of the requirements. Future projects may choose to utilize the lists of requirements as a reference or tool to develop specific requirements that address the needs of that project's stakeholders.

For all projects that are funded with highway trust funds the Final Rule states that the project should be based on a system engineering analysis, and specifically calls out that the analysis shall include requirements definition. The intent of the Corridor Architecture functional and interface requirements is to provide a set of requirements that can be used to assist project implementers in the development of future projects in coordination with the existing/planned projects currently defined. This does not preclude future projects from identifying different or additional functions, but rather, provides requirements to consider when implementing aspects of the statewide architecture.

Functional Requirements

Provided below is an initial set of functional requirements. These requirements are taken for the most part from the Bay Area Regional ITS Architecture. The system refers to the Traffic Operations System in Solano County.

Traffic Control (1.1)

1.1.1 The system shall include a vehicle detection function capable of accurately detecting vehicles on the freeway in real-time.

1.1.2 The system shall include a data collection function capable of collecting data that are needed for monitoring traffic conditions, determining traffic flow and making decisions

for congestion levels, ramp metering and travel times, both in real-time and for general planning and evaluation of system management strategies.

1.1.3 The system shall have the capability of processing data for the dissemination of traffic advisory messages.

1.1.4 The system shall have institutional measures and agreements in place to minimize the impact of ramp metering to the local surface streets.

1.1.5 The system shall integrate the monitoring and control of traffic signals with the monitoring and control of freeways, to the extent feasible.

1.1.6 The system shall provide preferential treatment for HOV.

1.1.7 The system shall seek to optimize traffic movement throughout the freeway corridors.

1.1.8 The system shall be demand responsive.

1.1.9 The system shall have the ability to communicate with ramp meters, message signs and highway advisory radios to exchange control data and operational status.

1.1.10 The system shall have the ability for the operator to manually override the system's automatic control.

1.1.11 The system shall provide the operator the capability to adaptively change system response to coordinate with other systems.

Traveler Information (1.2)

1.2.1 The system shall provide accurate information concerning available travel options and their operational availability including current traffic conditions, incidents, construction activities, travel speeds on specific routes, detours, road closures, recommended routes and event information.

1.2.2 The system shall provide real-time information concerning congestion.

1.2.3 The system shall provide the capability for travelers to receive real-time and predicted travel information en route including expected travel times and travel speeds along specific corridors.

Incident and Emergency Management (1.3)

1.3.1 The system shall have the ability to identify incidents and emergencies using traffic flow sensors and verify the incidents using CCTV cameras.

1.3.2 The system shall have the ability to continuously monitor the impact of an incident or emergency.

1.3.3 The system shall have the ability to disseminate real-time incident and emergency-related information to travelers.

1.3.4 The system shall be part of an overall coordinated system for traffic management under evacuation scenarios.

1.3.5 The system shall be able to request alerts on appropriate dissemination devices, e.g. 511 floodgates.

1.3.6 The system shall provide the capability to track the availability of resources and assist in the appropriate allocation of resources for a particular incident or emergency response.

1.3.7 The system shall provide the capability to request special traffic control measures, such as signal preemption, from a traffic management center to facilitate emergency vehicle progress along suggested routes.

1.3.8 The system shall provide the capability for system wide coordination under strategic emergency and incident response plans for large-scale incidents and disasters.

1.3.9 The system shall provide the capability to expand real-time emergency management response functions.

Other (1.4)

1.4.1 The system shall provide center-to-field connections to the Caltrans District 4 TMC.

Interface Requirements

Interface requirements, defined in terms of interconnects and information flows, are described in the following market package categories. Associated, tailored market package diagrams depict these interconnects and information flows in Appendix B.

- ATMS01 – Network Surveillance – includes traffic monitoring systems and detection to transmit traffic conditions to a central system.
- ATMS04 – Freeway Control – provides communications and field equipment to support freeway management including ramp metering, traffic surveillance, and traffic control.
- ATMS06 – Traffic Information Dissemination – Provides traffic conditions information to travelers using highway advisory radio and changeable message signs.
- ATMS08 – Traffic Incident Management – Includes management of planned and unplanned events. This category also includes field equipment used to detect incidents as well as coordination with other agencies to share information and respond to incidents using active traffic management.
- ATIS01- Broadcast Traveler Information – This category provides information to travelers about traffic conditions, incidents, emergencies, weather, or special events through regional information dissemination including websites.

Standards

This section describes the list of standards that can be used primarily for interagency or inter-system communications and data exchange. Very short descriptions are included, since it is anticipated that a long list of standards will not be utilized for every interface. The I-80/I-680/I-780 Corridors should use the adopted standards that are available at the time of design and implementation.

Traffic Control/Surveillance/Roadway Information Standards

The National Transportation Communications for ITS Protocol (NTCIP) is a standardization project funded by ITE, AASHTO, and others to develop standards for ITS communication. The NTCIP

standards are divided into groups based on the function of each standard. Figure 4-3 shows the NTCIP framework. The main important point of this figure is that the ITS standards for data exchange most significantly apply to the upper levels of the framework, namely the Information Level. The framework allows for the use of the commercially available communications equipment and protocols for the actual transport of the information across networks and systems.

The NTCIP 1100 series addresses the encoding and transfer of base information between the field devices and a central system.

- NTCIP 1102 – Octet Encoding Rules (OER) Base Protocol
- NTCIP 1103 – Transportation Management Protocols (TMP)

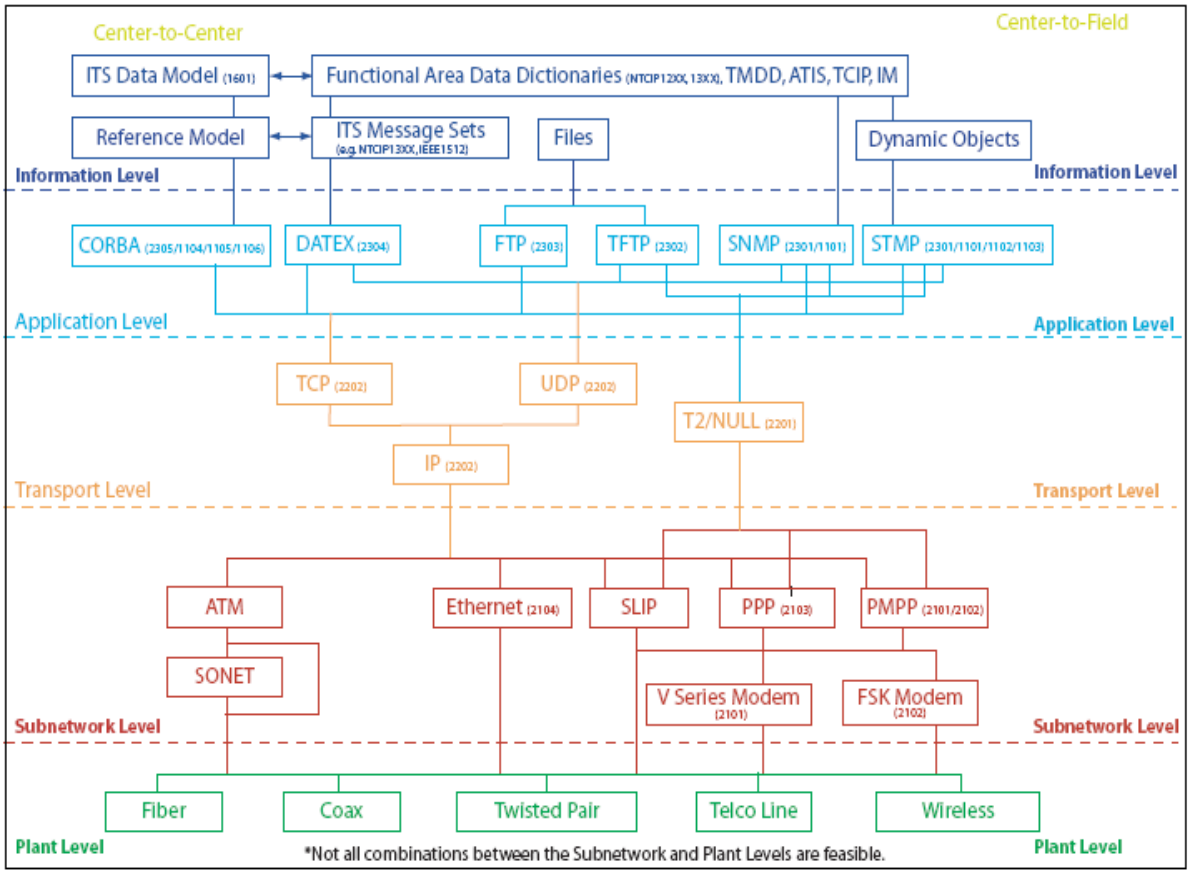


Figure 4-3: NTCIP Framework (source: NTCIP Guide)

The NTCIP 1200 series addresses information transmission specific to field devices.

- NTCIP 1202 – Object Definitions for Actuated Traffic Signal Controller
- NTCIP 1203 – Object Definitions for Dynamic Message Signs
- NTCIP 1205 – Object Definitions for CCTV Camera Control
- NTCIP 1207 – Object Definitions for Ramp Meter Control Units
- NTCIP 1208 – Object Definitions for CCTV Camera Switching
- NTCIP 1209 – Data Element Definitions for Transportation Sensor Systems

- NTCIP 1211 – Object Definitions for Signal Control and Prioritization

The NTCIP 2100 series defines communication protocols on the subnetwork level, which is physical communication connection such as a modem.

- NTCIP 2103 – Point to Point Protocol over RS 232 Subnetwork Profile
- NTCIP 2101 – Point to Multi-Point Protocol using RS 232 Subnetwork Profile
- NTCIP 2102 – Point to Multi-Point Protocol Using FSK Modem Subnetwork Profile
- NTCIP 2104 – Ethernet Subnetwork Profile

The NTCIP 2200 series addresses the transport level of communication, which involves data packet subdivision and reassembly.

- NTCIP 2201 – Transportation Transport Profile
- NTCIP 2202 – Internet (TCP/IP and UDP/IP) Transport Profile

The NTCIP 2300 series defines application profiles for the structure of data.

- NTCIP 2301 – Simple Transportation Management Framework (STMF) Application Profile
- NTCIP 2302 - Trivial File Transfer Protocol (TFTP) Application Profile
- NTCIP 2303 – File Transfer Protocol (FTP) Application Profile
- NTCIP 1201 – Global Object Definitions

Center to Center Standards

The Center to Center connections between the Caltrans TMC and other agencies are being established under the Interim C2C System to connect the TOS with the Smart Corridors together to exchange data and video, but not emergency information as of yet. Any new connections as a result of this project will follow the standards and protocols as part of that system. Thus, the new devices installed on the I-80/I-680/I-780 Corridors would be part of that system given that new freeway devices would be part of the TOS.

The Interim Guidance on Real-Time Information Program provides information on Center to Center standards recommended for statewide use. The following standards are mentioned in the Interim Guidance and may be adopted by the Partnership as the projects get closer to implementation. It should be noted that many of these standards are not mature and are not yet adopted by the state. The advantage of these standards is their recognition by FHWA as national standards.

- IEEE 1512 Base Standards Message 6.3 – Standard for Common Incident Management Message Sets for use by Emergency Management Centers
- SAE J2354 Message Sets for Advanced Traveler Information System
- TMDD – Traffic Management Data Dictionary Standards – these standards are not yet published.

4.2.3 Proposed Traffic Operations System and Implementation Plan

The Proposed System will fill in the gaps of the existing system in terms of TOS elements. The new elements that are recommended include all of the existing ITS element types including ramp meters. However, for this Architecture, ramp metering is the only element that is not currently installed and operating along the three corridors.

Based on the FPI recommendations on I-80 and I-680, ramp meters are recommended at all on-ramps throughout the project area. The communications infrastructure and integration of devices will need to be addressed during the design of the ITS elements.

As described in Section 4.2.1, an update to the Regional Architecture is recommended to account for the new ITS Elements identified under this study. Figure 4-4 provides a high level representation of the proposed TOS with the addition of the ramp metering system.

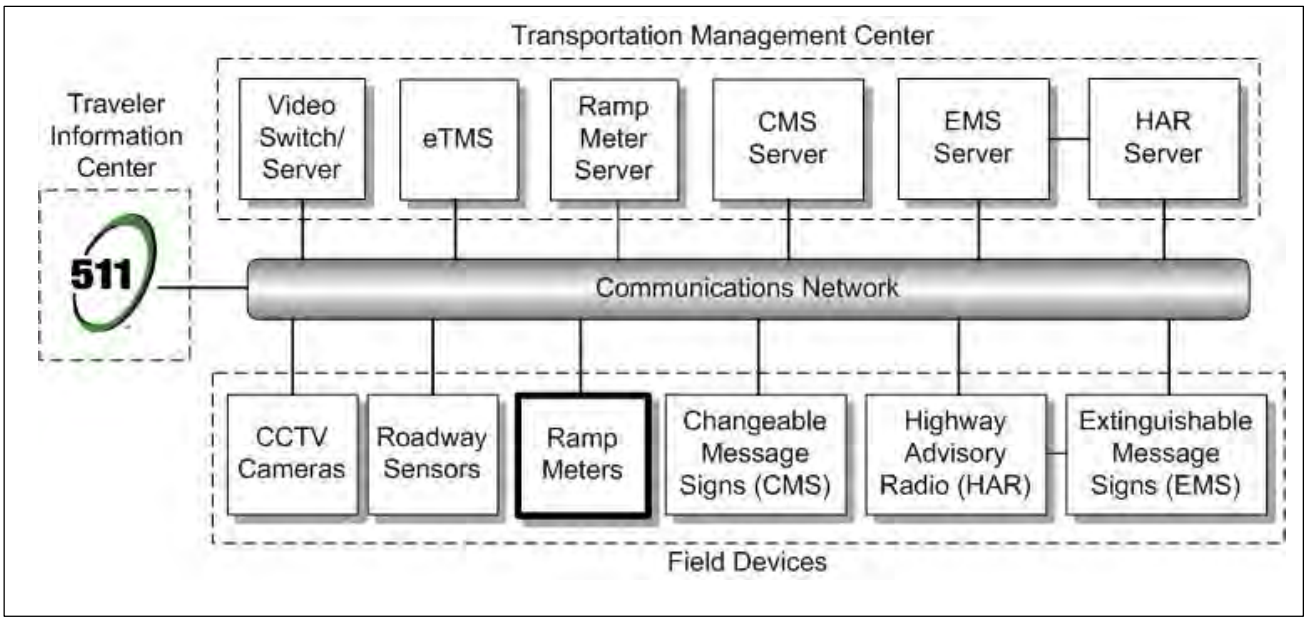


Figure 4-4: High Level TOS Diagram - Proposed

ITS Elements

The following ITS elements are recommended to fill in the gaps of the existing system and to provide more comprehensive data coverage. The addition of a ramp metering network will also maximize the efficiency of the network and is a significant operational strategy identified in the FPI studies. The following sections describe the recommendations for the installation of ITS elements along the freeway corridors.

Ramp Metering

There are no existing ramp metered locations in Solano County. The Freeway Performance Initiative Studies for I-80 and I-680 provide recommendations for specific locations for the installation of ramp metering under the short (Year 2015) and long term (Year 2030) time frames. The issue of freeway-to-freeway metering, e.g., I-680 to I-80 is not recommended in the Freeway

Performance Initiative Studies. Recommendations for ramp metering along I-780 will be provided as part of this Solano Highways Operations Study. Table 3-4 provides the recommended locations for ramp metering along the I-80 and I-680 corridors.

Table 4-4: Recommended Ramp Meter Locations

Corridor	Segment	Direction	No. of Ramps	Year
I-80	Between Air Base Parkway and Alamo Drive	EB/WB	10	2015
	Green Valley and Suisun Valley Interchanges	EB/WB	3	2015
	Between SR29 and SR37	EB/WB	15	2030
	Between Alamo Drive and I-505	EB/WB	8	2030
	Between I-505 and County Line	WB	10	2030
I-680	Between County Line (Benicia Bridge) and I-80	NB	5	2015

Source: MTC Freeway Performance Initiative Studies.

The ramp meter system will consist of a Model 170 controller with an NTCIP-based ramp metering software and inductive loops to detect the presence of vehicles. The system should be equipped with the latest Caltrans firmware to control the ramp volumes, which is dynamically adjusted based on real-time conditions. Caltrans plans to roll out the Model 2070 controller for ramp meter installations.

Subject to the details of agreements between Caltrans and the Partnership, it is anticipated that the ramp meters will only operate during commute hours, and will be dark when not in use. In addition, the installation of queue detection loops will be installed at the approaches to the on-ramps as close as possible to the local surface streets. The purpose of these queue loops is to trigger an adjustment to the ramp metering rate when the vehicle queues begin to back up onto the surface streets. The detailed operating parameters for the ramp meters will be determined prior to implementation and turn on of the ramp meters on along each corridor.

Highway Advisory Radio

The study area currently has three HARs. There is one in advance of the interchanges between the three freeway corridors in the study area. An additional HAR is recommended on I-80 near Air Base Parkway to provide traveler information between the I-680 and I-505 interchanges. This will allow travelers to make route decisions in the event of construction or special events.

Changeable Message Signs

Changeable message signs are important source of traveler information for motorists. They are typically installed at key decision points. The I-780 Corridor is lacking CMS coverage, which is especially important because of the morning backup near the I-680 interchange. I-780 would benefit from an additional CMS signs near the I-680 interchange in the eastbound direction and in advance of the I-80 interchange westbound. Table 3-5 provides a list of the recommended locations for the installation of changeable message signs.

I-80 has a 9-mile gap without any message signs from post mile 4.2 to post mile 13.10. This area includes the Highway 37 interchange. It is recommended that two CMS (one in each direction) be

installed to close this gap. Additional CMS should be installed on I-80 at three additional locations on I-80 north of PM 17 to the County line to provide traveler information at regular intervals in northern Solano County.

I-680 has a 10 mile gap without CMS from post mile 1.2 to 10.2. It is recommended that two CMS (one in each direction) be installed to close this gap.

Table 4-5: Recommended New CMS Locations

Corridor	Location	Direction	No. of CMS
I-80	Near American Canyon Road	EB/WB	2
	Near Pleasants Valley Road	EB/WB	2
	Between Leisure Town Road and Meridian Road	EB/WB	2
I-680	Between Parish Road and Marshview Road	EB/WB	2
I-780	Between Glen Cove and I-80	WB	1
	Between 2nd Street and 7th Street	WB	1
	Total		**10**

EB = Eastbound; WB = Westbound

CCTV Cameras

CCTV cameras are typically installed at one mile spacings to provide for complete coverage of the freeway. Currently, there is only one CCTV on I-780. It is recommended that new CCTV cameras be installed at approximately one mile intervals along I-780. CCTVs are currently located at one-mile intervals on I-680. Therefore, no additional cameras are recommended there. I-80 has a four mile gap with no cameras from Redwood Street to American Canyon Road (post mile 4.4 to 8.1) and another gap from Air Base Parkway to the County line (post mile 17 to 42). It is recommended that these gaps along I-80 be filled in with new CCTV cameras spaced at one-mile intervals. It is also recommended that the new cameras utilize video encoding techniques similar to the cameras on other parts of I-680 or consistent with those used on under the BAVU project to minimize video integration costs. Table 4-6 provides the segments along the three corridors that are recommended for CCTV installations.

Table 4-6: Recommended New CCTV Camera Locations

Corridor	Segment	No. of Cameras
I-80	Redwood Street to American Canyon Road	3
	Air Base Parkway to the County line	23
I-680	None	--
I-780	Between I-680 and I-80	6
	Total	**32**

Detection

The existing detection is supplemented by wireless detectors located on I-80. The detectors should be spaced at quarter mile intervals to provide comprehensive data collection coverage. The data from the detectors is used for a variety of reasons including determining the impact of

an incident, identifying congestion in order to change ramp metering rates, calculating driving times and the general planning and evaluation of system management strategies.

Inductive loops are most frequently used because they have proven effective for many years and are widely available. They do require that parts of the freeway be closed to install and to maintain.

To provide short-term coverage, Caltrans has contracted with a vendor to provide wireless detection. This is a viable option to provide immediate coverage to the study area. Currently, the coverage on I-780 is almost nonexistent. It is recommended that detectors be installed every quarter mile on I-780 in both directions.

The detection coverage on I-680 is spotty and should be filled in to provide more complete coverage in both directions. Specifically, I-680 needs additional coverage from I-780 to Industrial Parkway (post mile 0.83 to 1.46), from north of Industrial Parkway to Lake Herman (post mile 1.85 to 3.03), from Lake Herman Road to Parish Road (post mile 3.03 to 5.06), from Marshview Road to Gold Hill Road (post mile 7.07 to 9.96), and from Gold Hill Road to Cordelia Road (post mile 9.96 to 11.56).

I-80 has detection coverage provided at half mile intervals, on average, with the eastbound direction having slightly less coverage. It is recommended that the gaps on the eastbound direction be filled in from Route 29 to Seqouia Street (post mile 0 to 1.09), from Redwood Street to Columbus Parkway – Highway 37 (post mile 4.55 to 5.46), from Highway 37 to south of American Canyon Road (post mile 6.5 to 7.5), from American Canyon Road to Jameson Canyon (post mile 8.17 to 11.40), and from Jameson Canyon to I-680 (post mile 11.40 to 13.02).

Additional detection is recommended on I-80 in the westbound direction from south of American Canyon Road to SR 37 (post mile 6.5 to 7.5), from south of Jameson Canyon to American Canyon (post mile 9 to 10.00), from I-680 to Jameson Canyon (post mile 11.4 to 12.6).

The detection coverage in the northern portion of I-80 is provided by wireless detection devices. These devices have half-mile to one-mile spacings. It is recommended to fill in some detection gaps near the I-80 and I-505 interchange and north Midway. Table 4-7 provides the segments along the three corridors that are recommended for system detector installations.

Table 4-7: Recommended New Detection Segments

Corridor	Segment	Direction	No. of Detectors
I-80	Route 29 to Sequoia Street	EB	4
	Redwood Street to Columbus Parkway (Highway 37)	EB	4
	Highway 37 to south of American Canyon Road	EB	4
	American Canyon Road to Jameson Canyon	EB	13
	Jameson Canyon to I-680	EB	7
	Highway 37 to south of American Canyon Road	WB	4
	American Canyon to south of Jameson Canyon	WB	5
	Jameson Canyon to I-680	WB	4
	Texas Street to Meridian	EB/WB	8
	Kidwell to County Line	EB/WB	3
I-680	I-780 to Industrial Parkway	EB/WB	3

Table 4-7: Recommended New Detection Segments			
Corridor	**Segment**	**Direction**	**No. of Detectors**
	North of Industrial Parkway to Lake Herman	EB/WB	5
	Lake Herman Road to Parish Road	EB/WB	8
	Marshview Road to Gold Hill Road	EB/WB	11
	Gold Hill Road to Cordelia Road	EB/WB	6
I-780	Between I-680 and I-80	EB/WB	28
	Total		**117**

EB = Eastbound; WB = Westbound

Communications Infrastructure

The existing communication infrastructure on the freeway corridors consists primarily of leased lines connected to field devices. Caltrans is in the process of implementing a fiber backbone throughout the Bay Area. However, it may be many years before that backbone reaches Solano County. In the meantime, the Regional Transportation Plan (T2030) already requires that all freeway projects include TOS elements. This means that the freeway improvement projects identified in this Solano Highways Operations Study will need to include, amongst other things, communications infrastructure. Until a fiber communications backbone is established, the proposed TOS elements should be connected using some form of leased lines. The specific technologies to be utilized will be determined during the planning and design phases of those improvement projects.

Integration

The Caltrans Transportation Management Center (TMC) in downtown Oakland is the major hub for all data collection and traffic operations for the freeways in the Bay Area. Additionally, there is a hub located in Walnut Creek which connects the ITS field devices along the northern section of I-680. From that hub, there is a dedicated connection to the TMC. The TMC receives all of the data from the field elements and the operators are responsible for making changes to the field devices such as messages on the message signs and recorded messages on the HARs. The field devices will use the existing communications protocols for communicating with the TMC Systems and thus no additional integration is necessary.

Caltrans is in the process of implementing a new ATMS software at the District 4 TMC. This software will provide the new platform to monitor, operate and control the TOS elements. Thus, as part of the TOS expansion in Solano County, the new ITS devices will need to be integrated into this new ATMS platform.

Figure 3-5 shows the approximate locations of the proposed ITS elements for the three corridors.

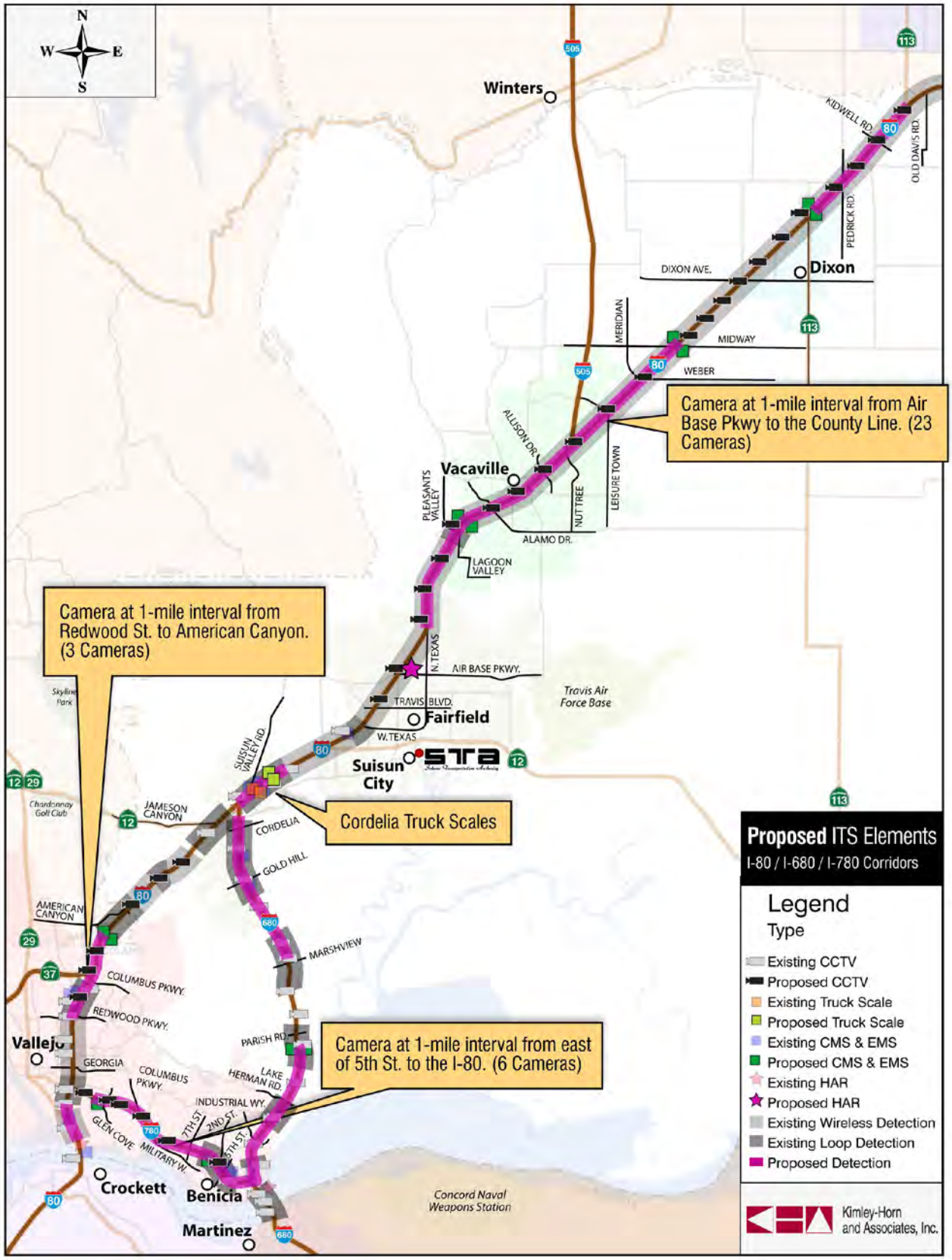


Figure 4-5: Proposed ITS Elements

Table 4-8: Summary of ITS Element Recommendations and Probable Costs				
Freeway Segment	**Location**	**Device**	**# of New Devices**	**Costs** [1]
I-80	Near Air Base Parkway (PM 19)	Highway Advisory Radio	1	75,000
	One in each direction near American Canyon (PM 8); One in each direction near Pleasant Valley (PM 23); One in each direction between Leisure Town and Meridian Rd. (PM 29 and 31), and One in each direction near the 113 interchange (PM 38).	Changeable Message Signs	8	4,800,000
	One mile intervals from Redwood St. to American Canyon (PM 4.4 to 8.1), and from Air Base Pkwy to the county line (PM 19 to 42)	CCTV Cameras	26	1,600,000
	¼ mile spacing in the eastbound direction from south of Route 29 to Sequoia St.; Redwood St. to Columbus Pkwy.; Highway 37 to south of American Canyon; American Canyon to Jameson Canyon and Jameson Canyon to I-680 (PM 0 to 1.09, 4.55 to 5.46, 6.5 to 7.5, 8.17 to 11.4, 11.4 to13.02) ¼ mile spacing in the westbound direction from Highway 37 to south of American Canyon; north of American Canyon to south of Jameson Canyon and Jameson Canyon to I-680 (PM 6.5 to 7.5, 9 to 10.0, and 11.4 to 12.63). Additional detection from Texas St. to Meridian Rd. (PM 21 to 31) ¼ mile spacing north of Kidwell Rd./113 to county line (PM 42 and north).	Detection	56	1,200,000
I-680	One in each direction between Parish Rd. and Marshview Rd. (PM 5-7.5)	Changeable Message Signs	2	1,200,000
	¼ mile spacing from I-780 to Industrial Way; north of Industrial to Lake Herman; Lake Herman to Parish Rd.; Marshview Rd. to Gold Hill Rd. and Gold Hill Rd. to Cordelia Rd. (PM 0.83 to 1.46, 1.85 to 3.03, 3.03 to 5.06, 7.07 to 9.96, and 9.96 to 11.56)	Detection	33	680,000

Table 4-8: Summary of ITS Element Recommendations and Probable Costs				
Freeway Segment	**Location**	**Device**	**# of New Devices**	**Costs [1]**
I-780	One in the westbound direction between Glen Cove and Laurel (PM 6 -7) One in the westbound direction between 2nd St and 7th St (PM 2-3)	Changeable Message Signs	2	1,200,000
	One mile intervals from east of 5th St. to I-80 (PM 1 – 7)	CCTV Cameras	6	360,000
	¼ mile spacing from I-680 to 2nd St. and from 2nd St. to Laurel St. (PM 0 – 1.8 and from 1.8 to 7.4)	Detection	28	560,000
Total Capital Cost				**$11,675,000**

[1] The costs include design, installation and integration.

The order of magnitude probable cost for the implementation of ITS devices along the three freeway corridors is approximately $12M. The number and locations of the field devices are to close the existing gaps of coverage to be consistent with Caltrans TOS implementation. It is anticipated that the actual implementation of ITS devices along the corridors will be part of operational improvements identified for the corridors to the extent possible. Otherwise, the ITS devices may be installed as part of separate ITS projects.

4.2.4 High Occupancy Toll (HOT) Lanes

The Bay Area High Occupancy Toll (HOT) Network Study, which was updated and approved by MTC in 2008, identified segments of I-80 and I-680 in Solano County as part of a potential HOT lane network. However, given that HOV lanes are just being constructed on I-80 in Solano County at present, the implementation of HOT lanes would be a conversion from these HOV lanes. As far as the System Architecture is concerned, the principles of the HOT Network adopted in July 2008 are as follows:

- Collaboration and Cooperation – Collaboration and Cooperation. To accomplish the objectives requires collaboration and cooperation by numerous agencies at several levels of government, including the Congestion Management Agencies (CMA), Caltrans, California Highway Patrol (CHP) and the Bay Area Toll Authority (BATA). This collaborative process shall establish policies for implementation of the HOT network including, but not limited to, (a) phasing of HOV conversion and HOT construction, (b) phasing of corridor investment plan elements, and (c) occupancy and pricing policies for HOT network operations.

- Corridor-based focus and implementation - Utilize a corridor-based structure that recognizes commute-sheds and geographic communities of interest as the most effective and user-responsive models for Bay Area Express/HOT Lane facilities implementation.

- Reinvestment with the corridor – Recognize that popular, political and legislative support will rest on demonstrating that the revenues collected in a corridor benefit travelers – including the toll payers – in the corridor through a variety of mechanisms, including additional capital improvements on the freeway and parallel arterials, providing support for transit capital and operations that increase throughput capacity in the corridor, and providing funds for enhanced operations and management of the corridor.

- Corridor investment plans - Developed by stakeholder agencies within the corridor, will direct reinvestment of revenues to capital and operating programs serving the corridor, commensurate with the revenue generated by each corridor.

- Simple system – Users deserve a simple, consistent and efficient system that is easy to use and includes the following elements: (a) consistent geometric design; (b) consistent signage; (c) safe and simple operations; (d) common technology; and(e) common marketing, logo and terminology.

- Toll collection – BATA shall be responsible for toll collection.

- Financing - A collaborative process will determine the best financing mechanism, which could include using the state owned toll bridge enterprise as a financing pledge to construct the network.

These principles will guide the deployment of HOT lanes in Solano County, particularly the specific partners, including BATA which is designated as the toll collection entity.

Four HOT lane corridor demonstration projects are scheduled to open in the Bay Area by 2013 under existing state legislative authority. The first of these will open on I-680 over the Sunol Grade in 2010. The other demonstration corridors include I-580 eastbound through the Tri-Valley, and US 101 and State Route 85 in Santa Clara County. The implementation of the first HOT Lane on I-680 in Alameda and Santa Clara County will provide much of the lessons learned and directions for any HOT lanes in Solano County. Figure 4-6 provides a potential system architecture for HOT Lanes in Solano County.

It should be noted that the Freeway Performance Initiative Studies for I-80 included operational improvements for Short-Term (to 2015) and Long-Term (to 2030), while the Bay Area HOT Network Study has HOT lane implementation horizons for 2015 and 2025. A portion of I-80 that is currently having HOV lanes constructed is identified to have HOT lanes by 2015 (short-term), and the full I-80 corridor by 2025 (long-term). Thus, HOT lanes in Solano County should be considered as a short-term ITS strategy. As the other Bay Area HOT lanes are implemented, the System Architecture will need to be revised accordingly to account for any changes as a result of those deployments.

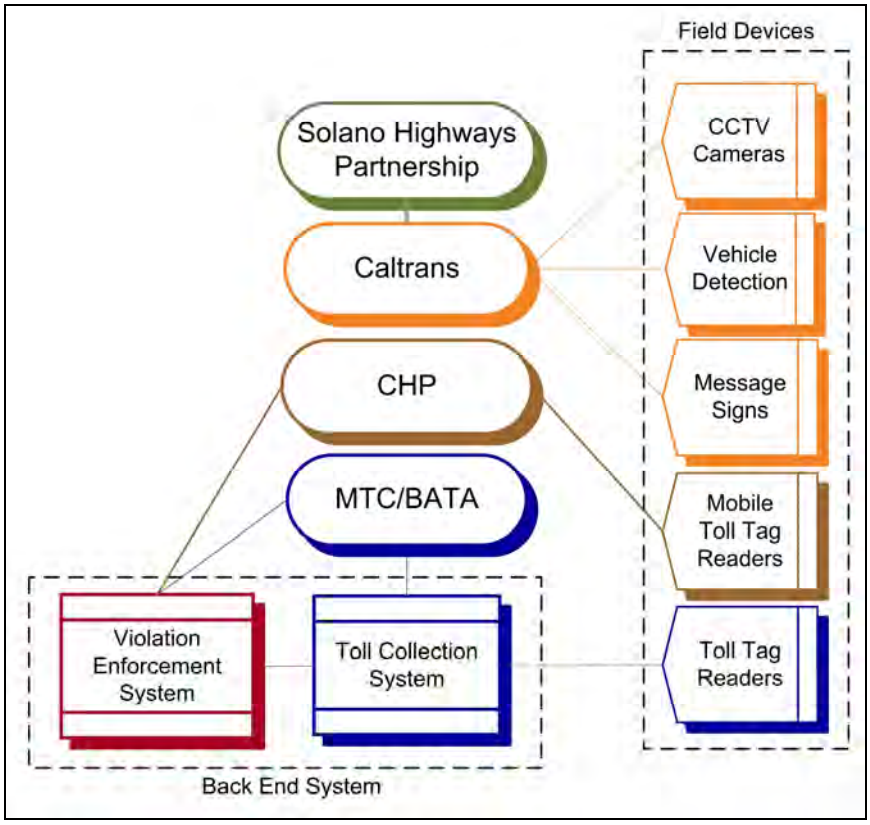


Figure 4-6: Potential Solano County HOT Lane System Architecture

4.2.5 Other Advanced ITS Strategies (Tier 2)

A number of innovative ITS strategies with potential in Solano County could be considered as "Advanced ITS Strategies". These strategies are categorized as those strategies that have not been deployed on any freeway in the Bay Area. However, for the most part they utilize the common ITS technologies in a more integrated manner. Some of the feasible strategies include the following:

- Adaptive Ramp Metering
- Active Traffic Management
    - Speed Harmonization - Variable Speed Limits
    - Lane Management
    - Diversion Management

Each of these Tier 2 strategies is described in more detail below. It should be noted that these Tier 2 strategies are future initiatives being evaluated for implementation as part of the I-80 ICM project. Thus, they are discussed here simply for informational purposes only.

Adaptive Ramp Metering

An adaptive ramp metering system uses the same infrastructure as the traditional ramp metering system, but applies the ramp metering principles on a system wide level. In contrast, the current ramp metering systems used in the Bay Area collect and process traffic volumes (on-ramp and freeway mainline) for the specific location that the meters are installed. While the ramp meter rates are set to be demand responsive, they do not take into account the adjacent interchanges, upstream and downstream. An adaptive ramp metering system uses software algorithms that forecast when and where congestion will occur. The system then "adapts" to control upstream ramps, through ramp metering, in order to control congestion on the mainline. The system forecasts the traffic state at predetermined problem points (bottlenecks), and adjusts metering rates based on those forecasts. It treats the freeway network as sections where each section is defined as being between two successive detectors that have reliable data outputs. Some systems are based on traffic density, with the goal of maintaining real-time density below a pre-determined saturation density for each section of freeway.

Active Traffic Management

The definition of "Active Traffic Management" is the ability to dynamically manage recurrent and non-recurrent congestion based on prevailing traffic conditions. The key focus is the term "dynamically". The concept of Active Traffic Management focuses on trip reliability as it attempts to maximize the effectiveness and efficiency of the facility through a series of strategies implemented collectively and proactively. The goal is to increase throughput and safety through the use of integrated systems with new technologies, including the automation of dynamic deployments to optimize performance quickly and without the delay that occurs when operators must deploy operational strategies manually. Based on the efforts under the I-80 ICM, the different Active Traffic Management Strategies include:

- Speed Harmonization - Variable Speed Limits
- Lane Management
- Diversion Management

Speed Harmonization

This strategy uses variable speed limit signs to maintain a constant flow along a corridor as vehicles approach an area of congestion, an incident or a special event. The thought is that by maintaining a constant speed, the net result will be a reduction in accidents and an improvement in overall congestion flow.

Lane Management

This strategy uses lane assignment signs to open or restrict the use of specific lanes along a corridor. Part of the lane assignments could include the shoulders of the roadway. The thought behind this strategy is that by allowing more effective and seamless assignment of lanes, drivers can be transitioned earlier to utilize certain lanes in advance of congested areas or areas with incidents. This advance warning would serve to alert the drivers early and reduce the chances of more accidents occurring. For the I-80 ICM project, the use of Lane Management is proposed only for non-recurrent congestion such as during incidents, construction and special events.

Diversion Management

This strategy provides the tools to manage traffic flow around an incident or road closure. It uses several other elements including lane management signs, traveler information systems and potentially the local arterial systems to direct vehicles away or around an incident. This diversion routing can be on another freeway or a local arterial. Should a diversion route be along an arterial, integration with the arterial traffic management system will be necessary for this strategy to be effective. This integration with the local arterial management system is synonymous with a Smart Corridor System. Thus, this Active Traffic Management strategy includes the potential integration with Smart Corridor systems thus providing a suite of strategies to proactively manage an incident or road closure.

4.2.6 Next Steps

The Corridor-Level Architecture provides the framework for ITS deployment in the study area by identifying functional requirements, operational scenarios, recommended standards and recommendations for the placement of ITS field devices. The intent of the recommendations is based on closing gaps in the existing field elements and adding additional functionality to make the system operate more efficiently.

The next step is to incorporate the recommendations into the overall Solano Highways Operations Study including detailed project descriptions with costs and phasing. The agreements identified will also be included in the overall study. The timing for the initiation and execution of the agreements will be subject to the timeframes for the operational improvements identified in the Study.

10. 5. IMPLEMENTATION PLAN

This section presents the overall plan for implementing the operational improvements identified in the operations analysis. This includes the identification of specific projects based on the recommended operational and system management strategies, and also a prioritization of the specific projects and their respective year for implementation.

5.1 Project Identification

This process involved packaging the list of strategy packages identified in the FPI studies and the Corridor Level ITS Architecture and Implementation Plan, developing specific projects and organizing them in priority order. The purpose of developing the specific projects is to combine strategies as appropriate in order to realize the potential synergies when constructing the projects. In addition, combining or bundling the packages into discrete projects will enable each project to be funded and constructed separately. For example, ITS strategies were combined with operational improvement strategies where practical. One such case is where the installation of an auxiliary lane lends itself well to the installation of ITS devices including communications infrastructure, CCTV cameras and vehicle detection.

There were instances where individual strategies were left as standalone projects. In particular, system management strategies in the short-term scenarios (Year 2015) were left as individual projects. Under these cases, keeping these strategies as individual projects provides the ability to prioritize them in earlier years instead of combining them with an operational improvement that is slated for installation over the long-term (Year 2030).

5.2 Project Prioritization

Based on the findings of the operations analysis, the Corridor Level ITS Architecture and Implementation Plan, and the development of the specific projects, each project organized in priority order. Once the project bundling was developed, each project was prioritized using several factors including the following:

- Impact on reducing congestion;
- Cost;
- Balancing corridor improvements; and
- Overall Feasibility

Each project's impact on reducing congestion during the horizon year forecasts was documented in the FPI studies. Thus, the prioritization of the projects focused more on the timing and location of the projects within those horizon years.

The prioritization for the most part followed the order of the improvement packages identified in the FPI studies. Where there were deviations, these included ranking projects such that other freeway corridors would receive improvements in order to balance the order of the improvements (e.g., Project #6 versus Project #8). Additionally, ITS improvements were combined with other FPI packages (e.g., Projects #17 and #18) in order to realize synergies when constructing the projects. Other HOV gap filling projects were ranked lower except in those cases where they would provide a level of continuity (e.g., Project #11).
The most cost effective strategies for the corridors under the Year 2015 were the system management strategies, or ITS strategies. These types of strategies reduce the amount of non-recurrent congestion as they provide the tools and means to identify, respond to and clear incidents in a timely manner before the

incident has a severe impact on congestion. However, it is understood that having ITS coverage alone does not relieve congestion. Moreover, the approach to prioritization was to not only combine ITS with operational improvements, but also to order the installation of the projects such that meaningful segments of the freeways are covered with successive projects. To that end, in the near-term (2015), the implementation of ITS as standalone projects was ranked highest, which is consistent with the FPI.

The following sections provide a discussion of the recommendations for the projects in order of their priority.

Figures 5-1 to 5-6 provides a graphical summary of the congestion and prioritized projects along each of the freeway corridors.

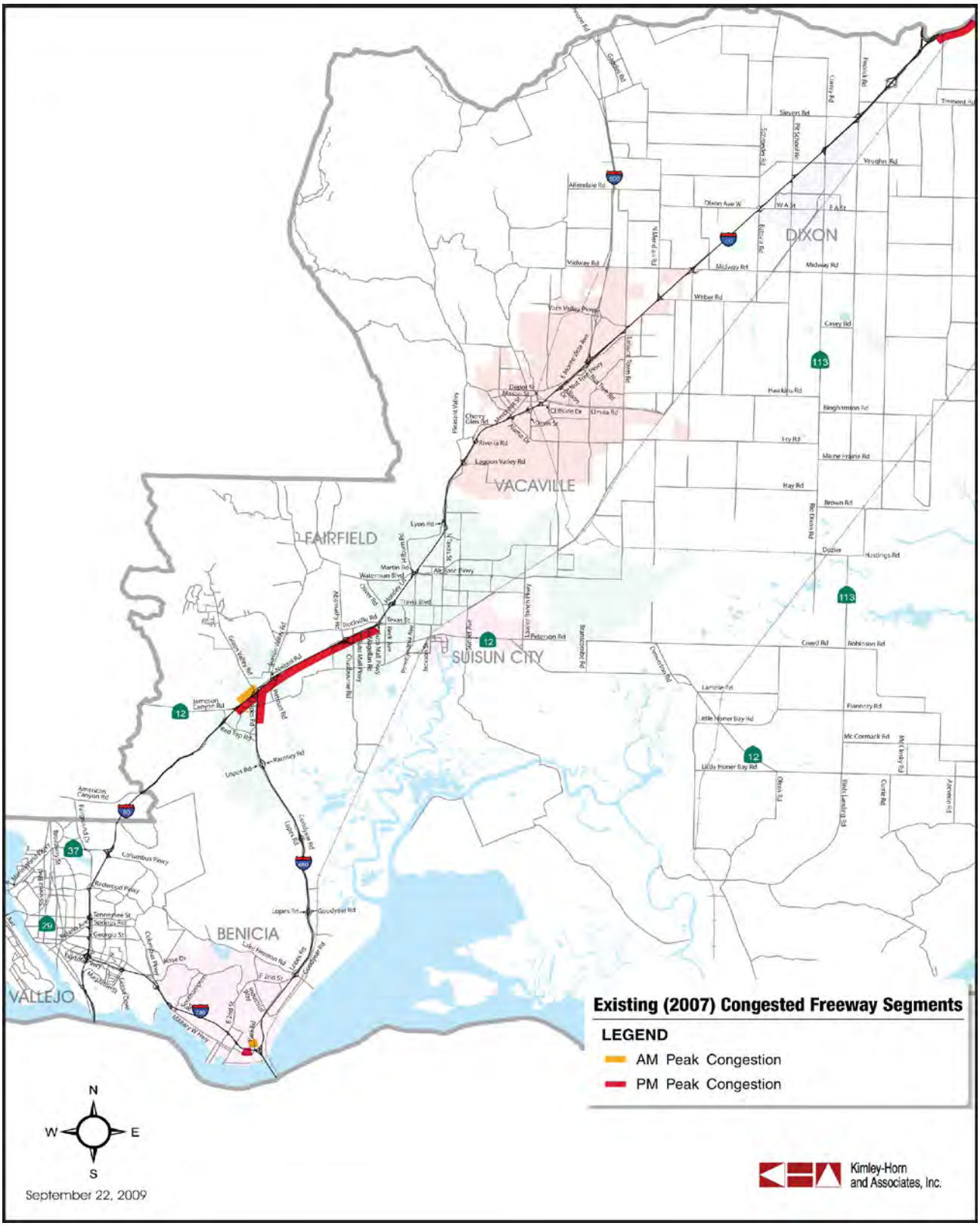


Figure 5-1: Existing Congestion

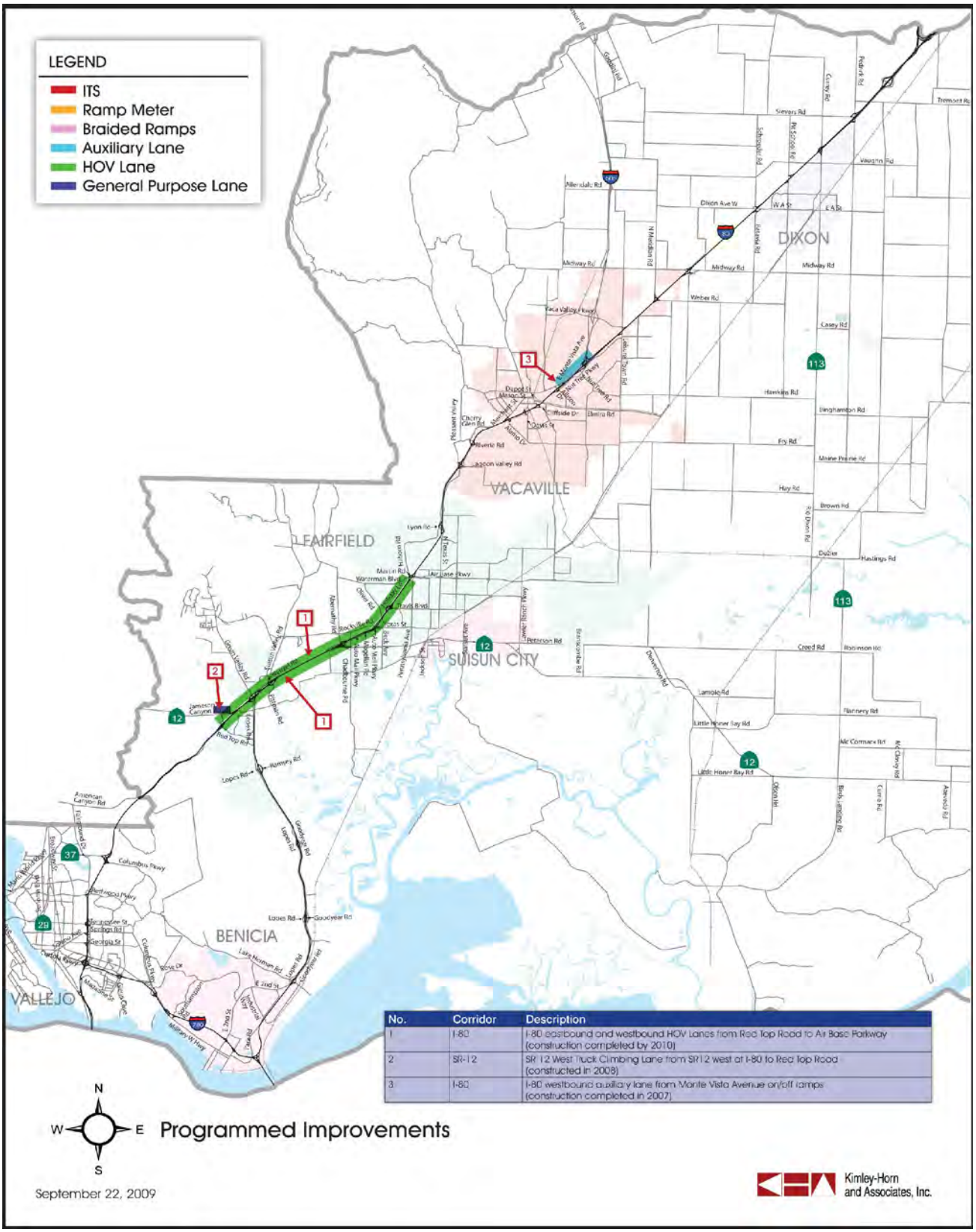


Figure 5-2: Programmed Improvements

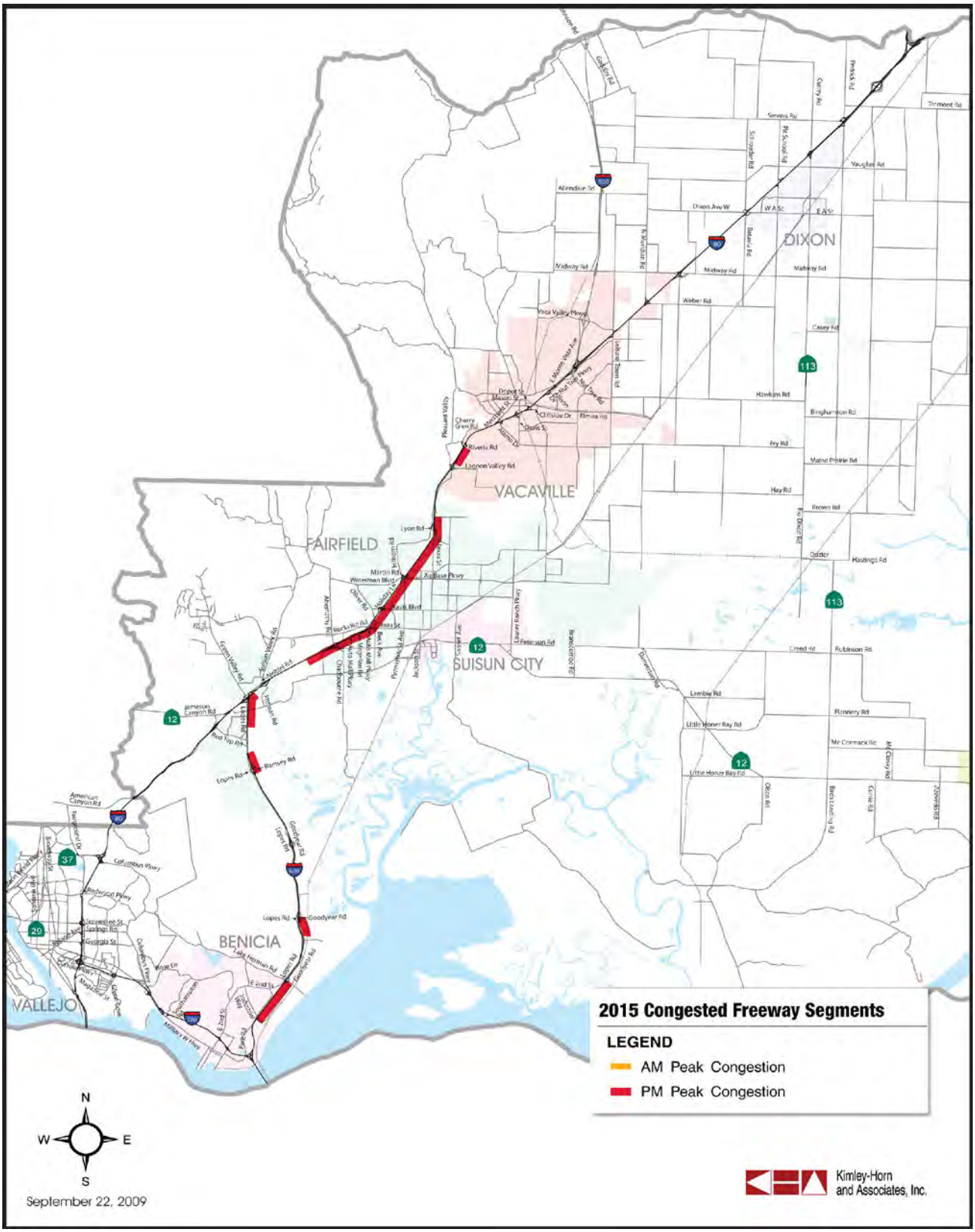
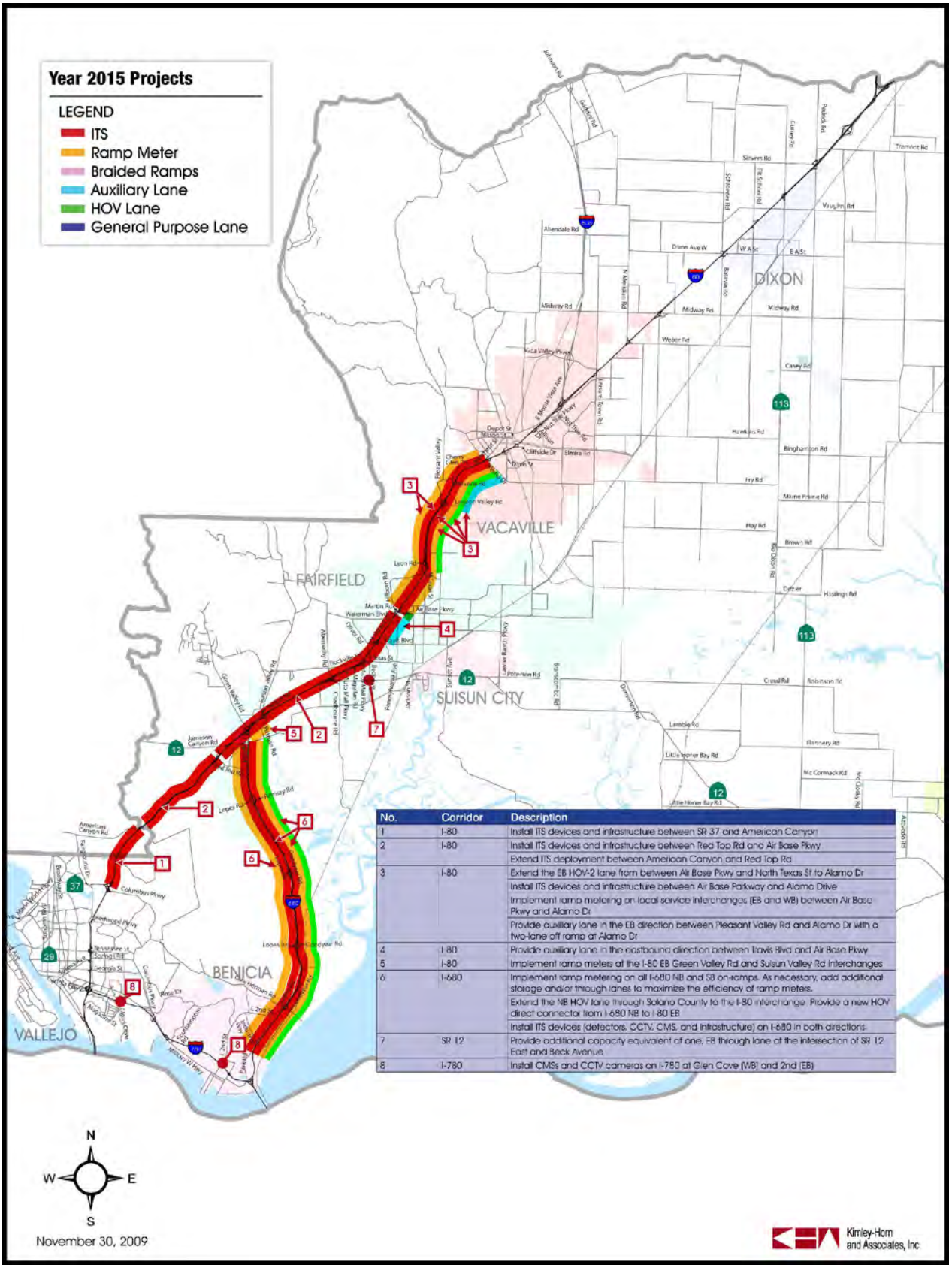


Figure 5-3: Year 2015 Congestion



No.	Corridor	Description
1	I-80	Install ITS devices and infrastructure between SR 37 and American Canyon
2	I-80	Install ITS devices and infrastructure between Red Top Rd and Air Base Pkwy
		Extend ITS deployment between American Canyon and Red Top Rd
3	I-80	Extend the EB HOV-2 lane from between Air Base Pkwy and North Texas St to Alamo Dr
		Install ITS devices and infrastructure between Air Base Parkway and Alamo Drive
		Implement ramp metering on local service interchanges (EB and WB) between Air Base Pkwy and Alamo Dr
		Provide auxiliary lane in the EB direction between Pleasant Valley Rd and Alamo Dr with a two-lane off ramp at Alamo Dr
4	I-80	Provide auxiliary lane in the eastbound direction between Travis Blvd and Air Base Pkwy
5	I-80	Implement ramp meters at the I-80 EB Green Valley Rd and Suisun Valley Rd interchanges
6	I-680	Implement ramp metering on all I-680 NB and SB on-ramps. As necessary, add additional storage and/or through lanes to maximize the efficiency of ramp meters.
		Extend the NB HOV lane through Solano County to the I-80 interchange. Provide a new HOV direct connector from I-680 NB to I-80 EB
		Install ITS devices (detectors, CCTV, CMS, and infrastructure) on I-680 in both directions
7	SR 12	Provide additional capacity equivalent of one, EB through lane at the intersection of SR 12 East and Beck Avenue
8	I-780	Install CMSs and CCTV cameras on I-780 at Glen Cove (WB) and 2nd (EB)

Figure 5-4: Year 2015 Proposed Improvements

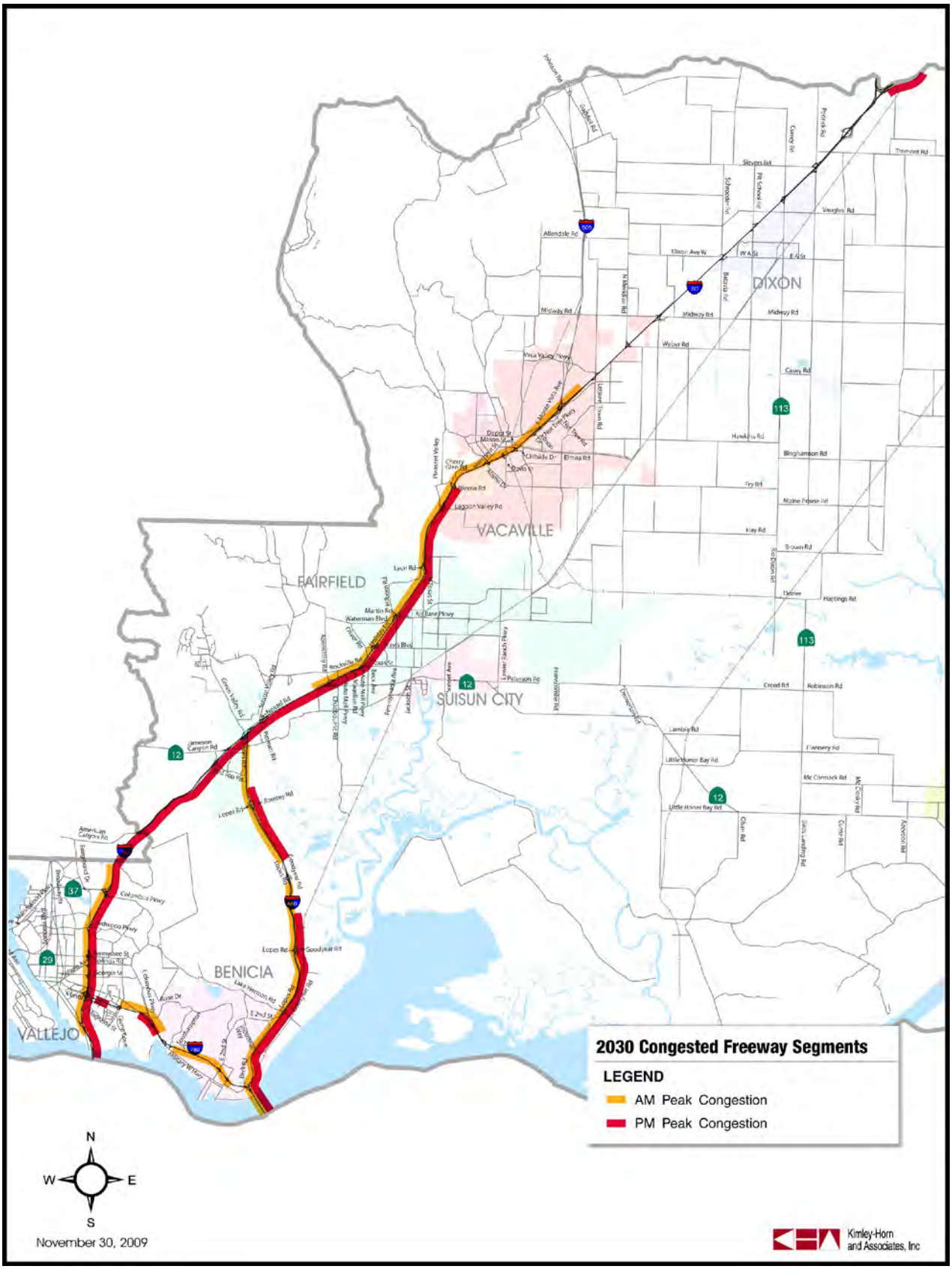
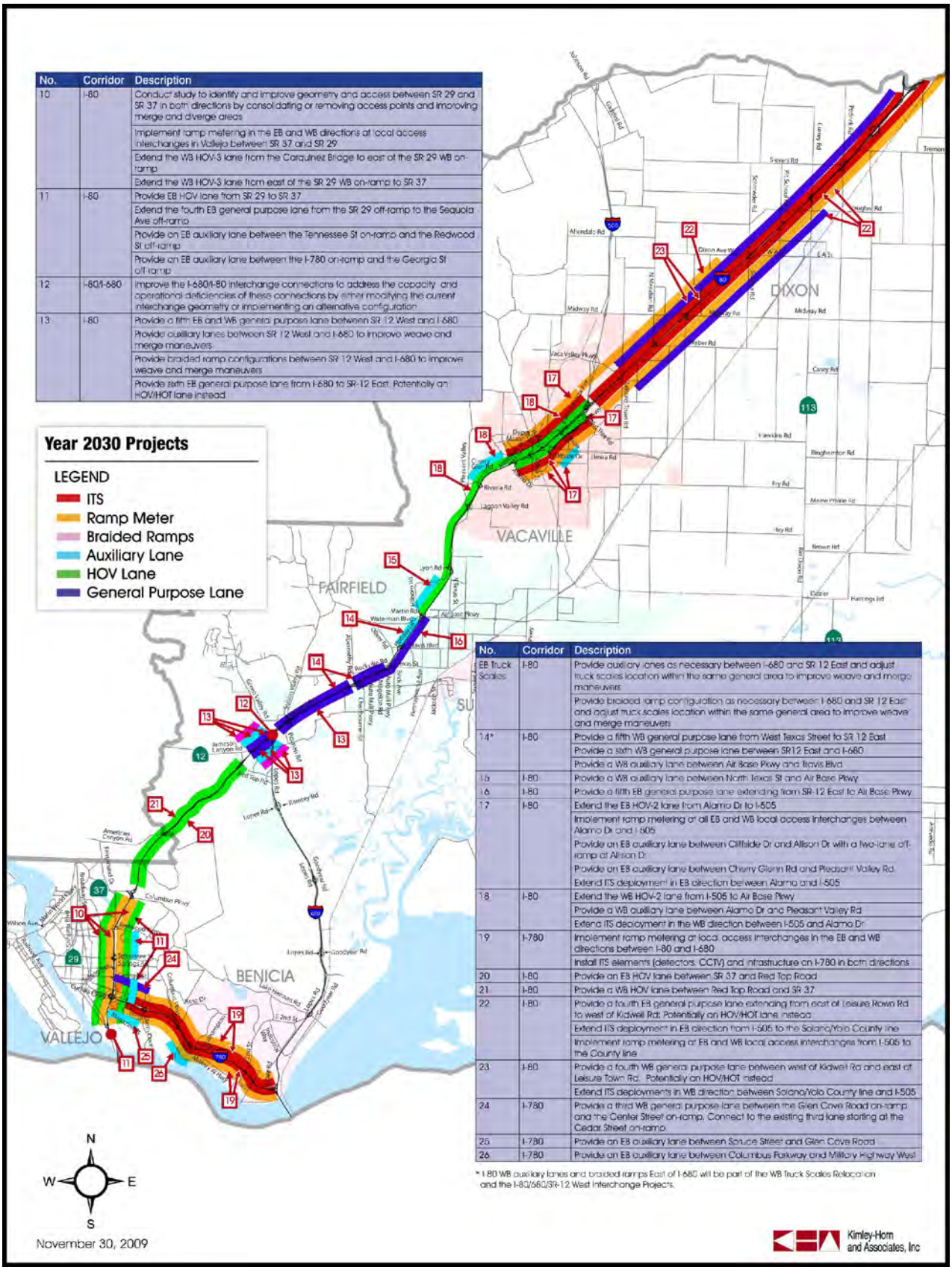


Figure 5-5: Year 2030 Congestion



No.	Corridor	Description
10	I-80	Conduct study to identify and improve geometry and access between SR 29 and SR 37 in both directions by consolidating or removing access points and improving merge and diverge areas
		Implement ramp metering in the EB and WB directions at local access interchanges in Vallejo between SR 37 and SR 29
		Extend the WB HOV-3 lane from the Carquinez Bridge to east of the SR 29 WB on-ramp
		Extend the WB HOV-3 lane from east of the SR 29 WB on-ramp to SR 37
11	I-80	Provide EB HOV lane from SR 29 to SR 37
		Extend the fourth EB general purpose lane from the SR 29 off-ramp to the Sequoia Ave off-ramp
		Provide an EB auxiliary lane between the Tennessee St on-ramp and the Redwood St off-ramp
		Provide an EB auxiliary lane between the I-780 on-ramp and the Georgia St off-ramp
12	I-80/I-680	Improve the I-680/I-80 interchange connections to address the capacity and operational deficiencies of these connections by either modifying the current interchange geometry or implementing an alternative configuration
13	I-80	Provide a fifth EB and WB general purpose lane between SR 12 West and I-680
		Provide auxiliary lanes between SR 12 West and I-680 to improve weave and merge maneuvers
		Provide braided ramp configurations between SR 12 West and I-680 to improve weave and merge maneuvers
		Provide sixth EB general purpose lane from I-680 to SR-12 East. Potentially an HOV/HOT lane instead

No.	Corridor	Description
EB Truck Scales	I-80	Provide auxiliary lanes as necessary between I-680 and SR 12 East and adjust truck scales location within the same general area to improve weave and merge maneuvers
		Provide braided ramp configuration as necessary between I-680 and SR 12 East and adjust truck scales location within the same general area to improve weave and merge maneuvers
14*	I-80	Provide a fifth WB general purpose lane from West Texas Street to SR 12 East
		Provide a sixth WB general purpose lane between SR12 East and I-680
		Provide a WB auxiliary lane between Air Base Pkwy and Travis Blvd
15	I-80	Provide a WB auxiliary lane between North Texas St and Air Base Pkwy
16	I-80	Provide a fifth EB general purpose lane extending from SR-12 East to Air Base Pkwy
17	I-80	Extend the EB HOV-2 lane from Alamo Dr to I-505
		Implement ramp metering at all EB and WB local access interchanges between Alamo Dr and I-505
		Provide an EB auxiliary lane between Cliffside Dr and Allison Dr with a two-lane off-ramp at Allison Dr
		Provide an EB auxiliary lane between Cherry Glenn Rd and Pleasant Valley Rd
		Extend ITS deployment in EB direction between Alamo and I-505
18	I-80	Extend the WB HOV-2 lane from I-505 to Air Base Pkwy
		Provide a WB auxiliary lane between Alamo Dr and Pleasant Valley Rd
		Extend ITS deployment in the WB direction between I-505 and Alamo Dr
19	I-780	Implement ramp metering at local access interchanges in the EB and WB directions between I-80 and I-680
		Install ITS elements (detectors, CCTV) and infrastructure on I-780 in both directions
20	I-80	Provide an EB HOV lane between SR 37 and Red Top Road
21	I-80	Provide a WB HOV lane between Red Top Road and SR 37
22	I-80	Provide a fourth EB general purpose lane extending from east of Leisure Town Rd to west of Kidwell Rd. Potentially an HOV/HOT lane instead
		Extend ITS deployment in EB direction from I-505 to the Solano/Yolo County line
		Implement ramp metering at EB and WB local access interchanges from I-505 to the County line
23	I-80	Provide a fourth WB general purpose lane between west of Kidwell Rd and east of Leisure Town Rd. Potentially an HOV/HOT instead
		Extend ITS deployments in WB direction between Solano/Yolo County line and I-505
24	I-780	Provide a third WB general purpose lane between the Glen Cove Road on-ramp and the Center Street on-ramp. Connect to the existing third lane starting at the Cedar Street on-ramp.
25	I-780	Provide an EB auxiliary lane between Spruce Street and Glen Cove Road
26	I-780	Provide an EB auxiliary lane between Columbus Parkway and Military Highway West

* I-80 WB auxiliary lanes and braided ramps East of I-680 will be part of the WB Truck Scales Relocation and the I-80/680/SR-12 West Interchange Projects.

Figure 5-6: Year 2030 Proposed Improvements

5.2.1 Estimates of Cost

The estimates of costs of each project and subset of each project was based on a high level estimate of quantities for each type of project. The items for the development of the 'Order of Magnitude' cost estimates included those for capacity and operational improvements and system management (ITS).

For the capacity and operational improvements (i.e., general purpose lanes, HOV lanes, and auxiliary lanes), the following items were accounted for:

- Roadway widening;
- New pavement sections;
- Median modifications;
- Bridge modifications;
- New overhead signs;
- Freeway lighting;
- Right of way; and
- Pavement delineation

For ITS improvements, the following items were accounted for:

- Communications infrastructure (conduit, pullboxes and fiber);
- CCTV cameras;
- Changeable message signs;
- Ramp meters; and
- Highway advisory radios.

Each order of magnitude estimate included allowances for project management, engineering, environmental, traffic control and a contingency.

5.2.2 Year 2015

The installation of system management strategies for the short-term was deemed the highest priority for the corridors, particularly for I-80. This was done, as system management are the most cost effective strategies for the corridor under the Year 2015 – this is supported by the mitigation strategies listed in the I-80 FPI report. These types of strategies reduce the amount of non-recurrent congestion as they provide the tools and means to identify, respond to and clear incidents in a timely manner before the incident causes congestion.

The I-80 corridor has many gaps in ITS coverage. Thus, the highest priority projects were identified to be those that implemented and closed the existing gaps in the ITS coverage. Next, combining ITS strategies with operational improvements was evaluated. In some cases, there were recommended operational improvements where the inclusion of ITS improvements would be appropriate. However, in most cases, the need for ITS coverage was not in locations that needed operational improvements. To that effect, the existing areas without ITS coverage that would benefit the most while still maintaining its cost effectiveness are along north Vallejo and through Fairfield along I-80.

The operational improvements that would reduce congestion along I-80 through the Fairfield and Vacaville areas were ranked high in priority (Project #3) since those improvements, which includes an eastbound HOV

lane and an auxiliary lane, would mitigate a substantial bottleneck in the eastbound direction. Additionally, the forecast of a series of congested locations and bottlenecks on I-680 in the northbound direction resulted in the need for operational improvements, i.e., HOV lane and ramp metering.

The I-80 operational improvements ranked higher than the I-680 improvements due to the levels of congestion and cost, where the congestion levels on NB I-680 are not projected to be as significant as I-80. Also, mitigating the I-80 bottleneck would be required before mitigating the NB I-680 bottlenecks since I-680 feeds into I-80. However, with one goal of maintaining a balance between corridors in terms of the order of project priorities, improvements along I-680 (Project #6) were ranked slightly higher than one system management strategy along I-80 (Project #8).

Under Projects #3 and #6, ITS improvements were combined with other operational improvements including HOV lanes, auxiliary lanes and ramp metering. Additionally, ramp metering implementations were packaged such that both directions at each interchange would be combined. As an example, I-680 (Project #6) includes SB ramp metering, even though the implementation of ramp metering along I-680 in the SB direction is not recommended until Year 2030 in the FPI.

The other projects in Year 2015 consisted of standalone ITS improvements along I-80 (Projects #1, #2 and #8) and I-780 (Project #9), and improvements at the intersection of SR12 East and Beck Avenue. For I-780, the installation of CMS and CCTV cameras at two locations near I-80 and I-680 are intended to provide some form of system management coverage in the short-term until such time as ITS improvements can be combined with other operational improvements.

For Year 2015, nine projects are recommended for deployment totaling approximately $131,000,000. Under this year, full ITS coverage along I-680 in the County and on I-80 from the Carquinez bridge to Alamo Drive would be achieved.

Table 5-1 provides a summary of the prioritized projects and their order of magnitude costs for the Year 2015.

Table 5-1: Year 2015 Prioritization of Projects

Priority	Corridor	Description	Order of Magnitude Cost
1	I-80	Install ITS devices and infrastructure between SR 37 and American Canyon Road. This will consist of CCTV cameras, changeable message signs and communications infrastructure.	$6,500,000
2	I-80	Install ITS gap between Red Top Road and Air Base Parkway. This will consist of CCTV cameras, Highway Advisory Radio and communications infrastructure.	$6,000,000
3	I-80	Extend the EB HOV-2 lane from between Air Base Parkway and North Texas Street to Alamo Drive.	$19,000,000
		Install ITS devices and infrastructure between Air Base Parkway and Alamo Drive	$7,800,000
		Implement ramp metering on local service interchanges (EB and WB) between Air Base Parkway and Alamo Drive. This will include four interchanges with eight on-ramps.	$2,200,000

Table 5-1: Year 2015 Prioritization of Projects			
Priority	**Corridor**	**Description**	**Order of Magnitude Cost**
		Provide an EB auxiliary lane between Pleasant Valley Road and Alamo Drive. Provide a two-lane off-ramp at Alamo Drive. This includes the EB auxiliary lane between Cherry Glen Road and Pleasant Valley Road.	$7,200,000
		Subtotal No. 3:	$36,200,000
4	I-80	Provide auxiliary lane in the EB direction between Travis Boulevard and Air Base Parkway. Install ITS devices and infrastructure.	$18,000,000
5	I-80	Implement ramp meters at the I-80 EB Green Valley Road and Suisun Valley Road interchanges	$550,000
6	I-680	Implement ramp metering on all I-680 NB and SB on-ramps. As necessary, add additional storage and/or through lanes to maximize the efficiency of ramp meters.	$2,700,000
		Install ITS elements (detectors, CCTV, CMS & Infrastructure) on I-680 in both directions	$9,200,000
		Extend the NB HOV lane through Solano County to the I-80 interchange. Provide a new HOV direct connector from I-680 NB to I-80 EB.	$44,100,000
		Subtotal No. 6:	$56,000,000
7	SR 12	Provide additional capacity equivalent of one, EB through lane at the intersection of SR 12 East and Beck Avenue	$2,900,000
8	I-80	Extend ITS deployment between American Canyon and Red Top Road	$3,600,000
9	I-780	Install CMS and CCTV cameras on I-780 at Glen Cove (WB) and 2nd Street (EB)	$1,400,000
		Total Year 2015 Improvements:	**$131,150,000**

5.2.3 Year 2030

Following the same process as Year 2015, the projects identified for Year 2030 were derived from bundling the improvement packages from the FPI and including system management strategies. As an example, Project #17 includes HOV lanes, auxiliary lanes, and ramp metering taken from the I-80 FPI Package F plus the implementation of ITS improvements.

For ramp metering, the projects were bundled such that both directions of the freeway corridors would implement ramp metering. Using Project #17 as an example, ramp metering in the WB direction was added to this project even though it was not part of FPI Package F.

The prioritization of projects in Year 2030 was generally divided into segments along the freeway corridors. The areas through Vallejo were ranked highest followed by areas through Fairfield and Vacaville (I-80 and I-680), through Benicia along I-780 and finally along I-80 through Dixon to the county line.

The operational improvements along I-80 through Vallejo (Projects #10 and #11) were prioritized higher partly to balance the set of improvements along I-80 to the west along with the costs and projected levels of congestion that the projects are anticipated to mitigate. Additionally, since this corridor segment has been

studied at length, it is anticipated that this segment may be the most prepared for the installation of the recommended operational improvements. There is already ITS coverage including CCTV cameras, CMS and vehicle detection along this segment. The projects include HOV lanes as part of the project bundle mainly for continuity and synergy of projects, e.g., since auxiliary lanes and ramp metering are recommended, adding in the EB HOV lane (Project #11) would provide continuity of the HOV lane from the Carquinez Bridge.

The improvements at the I-80/680/SR 12 interchange (Project #12), while prioritized lower than the I-80 segment through Vallejo, are currently being analyzed and developed, and the overall cost is anticipated to be significantly higher in comparison. Figures 5-7 and 5-8 illustrate the current concept for the I-80/680/SR 12 interchange. The improvements would create a direct I-680 and SR 12 connection, a direct HOV connection between I-80 and I-680, a new interchange at I-680 and Red Top Road, a new interchange on SR 12 West to facilitate the connection from WB SR 12 West and WB I-80, and a new overcrossing and improved interchange at Green Valley Road. The project is still in the environmental clearance stage of development.

The improvements in the vicinity between SR 12 West and SR 12 East (Projects #13 and #14) are forecast to have significant congestion such that additional general purpose and auxiliary lanes are needed in both directions of I-80. This influenced the high ranking of projects along this segment. The recommendations from the I-80 FPI were modified based on direction in order to account for the segment of I-80 EB that is currently being designed as part of the EB truck scales relocation project. Under this project, auxiliary lanes and braided ramps will be included. However, a sixth EB general purpose lane is not part of the current EB Truck Scales Relocation design.

The eastbound portion between Alamo Drive and I-505 is projected to have the potential for bottlenecks even with the recommended improvements. For this reason, the set of eastbound improvements are ranked just higher than the westbound improvements for this specific segment (Projects #17, #18, #22 and #23). The only exception is that ramp metering is recommended to be implemented in both directions.

The operational improvements and ITS installations along I-80, east of Alamo Drive (Projects #17 and #18), round out the recommended priority projects. The HOV lanes in both directions along I-80 between SR 37 and Red Top Road were identified as gap filling projects and thus were prioritized accordingly (Projects #20 and #21). One other point of discussion for this segment is that there is the possibility that the installation of High Occupancy Toll (HOT) lanes would be the extent of feasible improvements given the geometric and right of way constraints in the area. This is a topic that is beyond the limits of this study but will need to be addressed at a later time.

The operational improvements and ITS installations along I-80, east of Alamo Drive, round out the recommended priority projects. It is recommended that the eastbound improvements be installed before the westbound since the westbound improvements are primarily to fill in gaps. However, a similar point of discussion is noted for this segment regarding the potential for HOT lanes as a congestion mitigation strategy.

Along I-780, the implementation of ramp metering (Project #19) was ranked lower in priority as the levels of congestion forecast along this corridor are substantially less than the other corridors. However, this project, which includes full ITS coverage was prioritized ahead of the HOV gap filling projects along I-80 (Projects #20 and #21). A third general purpose lane on I-780 between Glen Cove and Cedar (Project #24) and auxiliary lanes along two segments (Projects #25 and #26) round out the list of projects.

For Year 2030, 17 projects are recommended for deployment totaling approximately $622,000,000. Under this year, full ITS coverage would be achieved along all three freeway corridors in the County. Table 5-2 provides a summary of the prioritized projects and their order of magnitude costs.

5.2.4 Comparison with FPI and I-80/680/780 MIS Studies

A comparison of the three different studies including the I-80/680/780 MIS (2004), the Freeway Performance Initiative (2007) and this Solano Highways Operations Study was conducted to account for the recommendations that have been made along these corridors in order to ensure that there is a continuity and overall coverage of the three corridors. Table 5-3 below provides the comparison of the three studies by project reference name.

HOV Lane Implementation

The implementation of HOV (HOV-2 and HOV-3) lanes along the three corridors will take place in phases over the short and long term. The first HOV-2 lane implementation will open in 2009 between Red Top Road and Air Base Parkway. Figure 5-8 illustrates the planned implementation of HOV lanes by corridor segment, horizon year and occupancy.

Highway Project Planning

As highway projects are identified in the Solano County area, it is recommended that these future highway planning efforts take into consideration all modes of travel along the study corridors, as well as the impacts of rising sea level, as required by State Law.

Table 5-2: Year 2030 Prioritization of Projects			
Priority	**Corridor**	**Description**	**Order of Magnitude Cost**
10	I-80	Conduct study to identify and improve geometry and access between SR 29 and SR 37 in both directions by consolidating or removing access points and improving merge and diverge areas.	$500,000
		Implement ramp metering in the EB and WB directions at local access interchanges in Vallejo between SR 37 and SR 29	$3,500,000
		Extend the WB HOV-3 lane from the Carquinez Bridge to east of the SR 29 WB on-ramp	$3,800,000
		Extend the westbound HOV-3 lane from east of the SR 29 westbound on-ramp to SR 37	$14,900,000
		Subtotal No. 10:	$22,700,000
11	I-80	Provide an EB HOV lane from SR 29 to SR 37	$15,200,000
		Extend the fourth EB general purpose lane from the SR 29 off-ramp to the Sequoia Avenue off-ramp	$3,000,000
		Provide an EB auxiliary lane between the Tennessee Street on-ramp and the Redwood Street off-ramp	$13,800,000
		Provide an EB auxiliary lane between the I-780 on-ramp and the Georgia Street off-ramp	$9,200,000
		Subtotal No. 11:	$41,200,000
12	I-80/I-680	Improve the I-680/I-80 interchange connections to address the capacity and operational deficiencies of these connections by either modifying the current interchange geometry or implementing an alternative configuration	$100M (allocated)
13	I-80	Provide a fifth EB and WB general purpose lane between SR 12 West and I-680.	$23,000,000
		Provide WB auxiliary lanes as necessary between SR 12 West and I-680 to improve weave and merge maneuvers	$2,600,000
		Provide WB braided ramp configurations as necessary between SR 12 West and I-680 to improve weave and merge maneuvers	$4,200,000
		Provide sixth EB general purpose lane from I-680 to SR 12 East. *Potentially an HOV/HOT lane instead.*	$36,800,000
		Subtotal No. 13:	$66,600,000
EB Truck Scales	I-80	Provide EB auxiliary lanes as necessary between I-680 and SR 12 East and adjust truck scales location within the same general area to improve weave and merge maneuvers	(Part of EB Truck Scales Project)
		Provide EB braided ramp configuration as necessary between I-680 and SR 12 East and adjust truck scales location within the same general area to improve weave and merge maneuvers	(Part of EB Truck Scales Project)
14	I-80	Provide a fifth WB general purpose lane from West Texas Street to SR 12 East	$9,000,000
		Provide a sixth WB general purpose lane from SR 12 East to I-680	$11,500,000

Table 5-2: Year 2030 Prioritization of Projects			
Priority	**Corridor**	**Description**	**Order of Magnitude Cost**
		Provide a WB auxiliary lane between Air Base Parkway and Travis Boulevard	$12,000,000
		Subtotal No. 14:	$32,500,000
15	I-80	Provide a WB auxiliary lane between North Texas Street and Air Base Parkway.	$20,000,000
16	I-80	Provide a fifth EB general purpose lane extending from SR 12 East to Air Base Parkway	$40,300,000
17	I-80	Extend the EB HOV-2 lane from Alamo Drive to I-505	$19,200,000
		Implement ramp metering at all EB and WB local access interchanges between Alamo Drive and I-505	$2,800,000
		Provide an EB auxiliary lane between Cliffside Drive and Allison Drive with a two-lane off-ramp at Allison Drive	$3,500,000
		Provide an EB auxiliary lane between Cherry Glenn Road and Pleasant Valley Road	$9,200,000
		Extend ITS in EB direction between Alamo Drive and I-505	$2,300,000
		Subtotal No. 17:	$37,000,000
18	I-80	Extend the WB HOV-2 lane from I-505 to Air Base Parkway	$32,800,000
		Provide a WB auxiliary lane between Alamo Drive and Pleasant Valley Road	$4,400,000
		Extend ITS in the WB direction between I-505 and Alamo Drive	$2,000,000
		Subtotal No. 18:	$39,200,000
19	I-780	Implement ramp metering at local access interchanges in the EB and WB directions between I-80 and I-680	$4,400,000
		Install ITS elements (detectors, CCTV and infrastructure) on I-780 in both directions	$6,700,000
		Subtotal No. 19:	$11,100,000
20	I-80	Provide an EB HOV lane between SR 37 and Red Top Road	$36,000,000
21	I-80	Provide a WB HOV lane between Red Top Road and SR 37	$36,000,000
22	I-80	Provide a fourth EB general purpose lane extending from east of Leisure Town Road to west of Kidwell Road. *Potentially an HOV/HOT lane instead.*	$78,000,000
		Extend ITS in EB direction from I-505 to the Solano County line	$8,100,000
		Implement ramp metering at EB and WB local access interchanges from I-505 to the County line	$4,700,000
		Subtotal No. 22:	$90,800,000
23	I-80	Provide a fourth WB general purpose lane between west of Kidwell Road and east of Leisure Town Road. *Potentially an HOV/HOT lane instead.*	$132,300,000

Table 5-2: Year 2030 Prioritization of Projects			
Priority	**Corridor**	**Description**	**Order of Magnitude Cost**
		Extend ITS in WB direction between Solano/Yolo County line and I-505	$8,000,000
		Subtotal No. 23:	$140,300,000
24	I-780	Provide a third WB general purpose lane between the Glen Cove Road on-ramp and the Cedar Street on-ramp. Connect to the existing third lane starting at the Cedar Street on-ramp.	$4,100,000
25	I-780	Provide an EB auxiliary lane between Spruce Street and Glen Cove Road	$2,900,000
26	I-780	Provide an EB auxiliary lane between Columbus Parkway and Military Highway West	$2,900,000
		Total Year 2030 Improvements:	**$623,600,000**

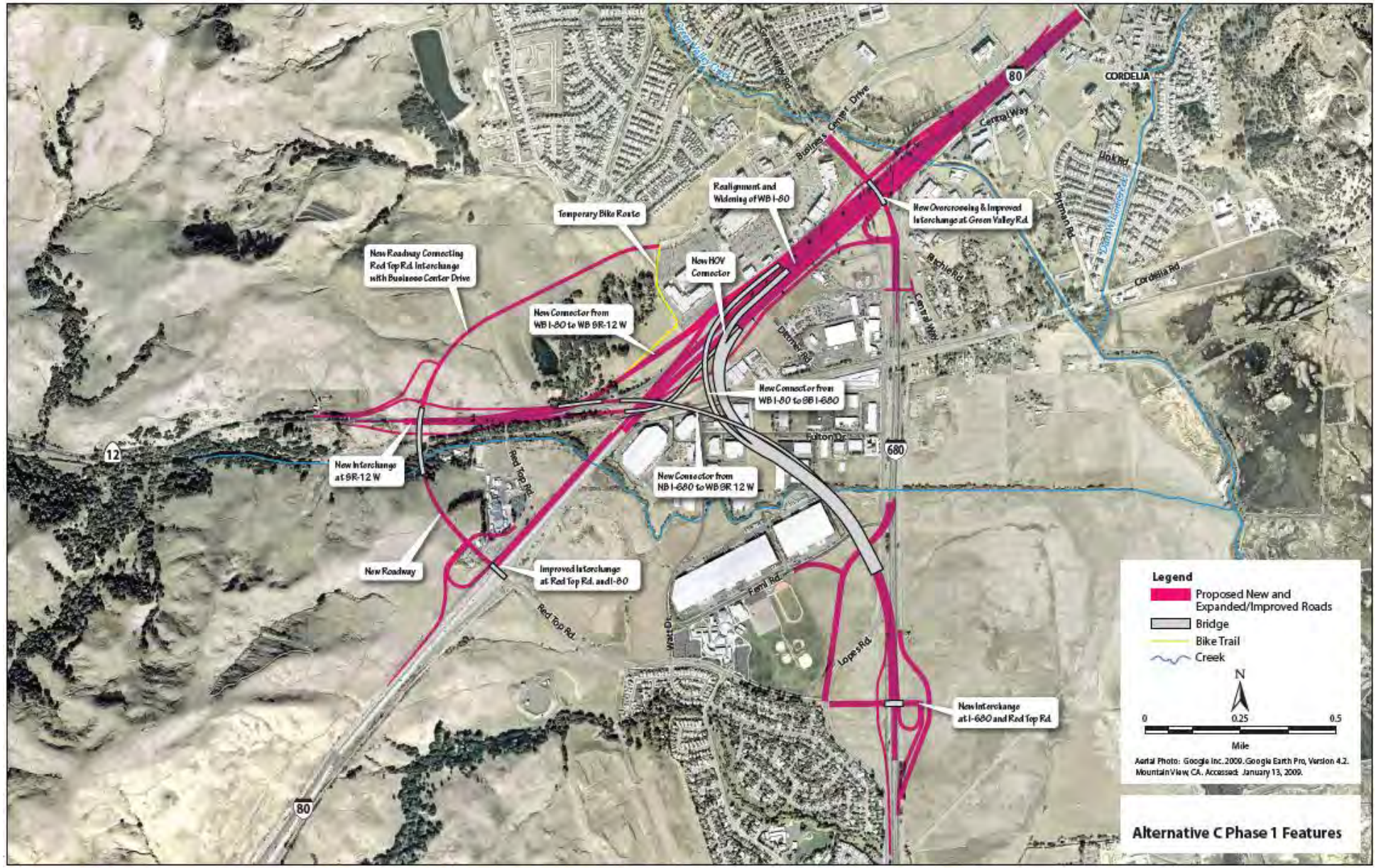


Figure 5-7: Alternative Concept for the I-80/I680/SR 12 W Interchange

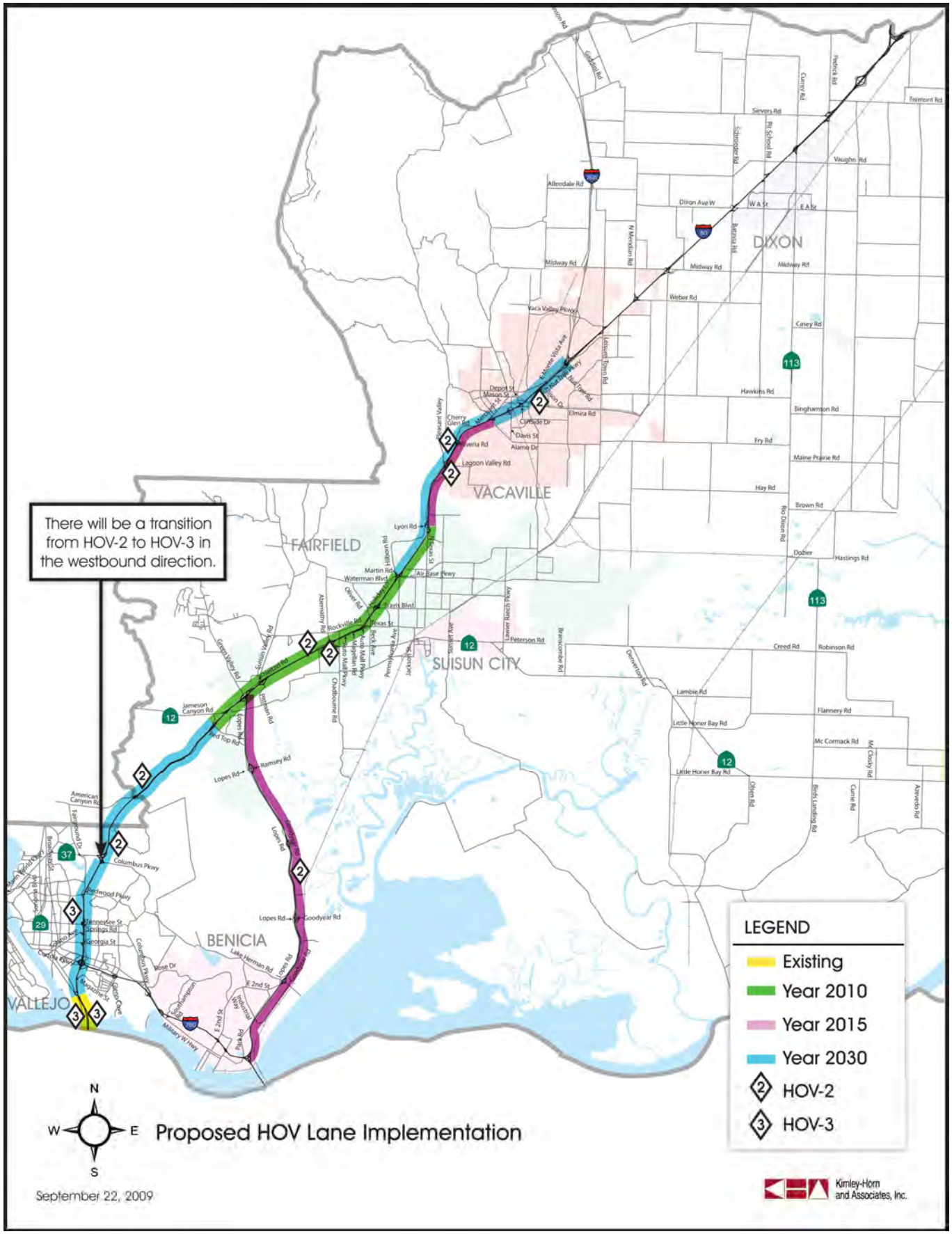


Figure 5-8: Proposed HOV Implementation Plan

Table 5-3: Comparison of Recommended Projects							
FPI Strategy Package	**FPI Package No.**	**I-80/I-680/I-780 MIS ID**	**Strategy Type**	**Corridor**	**Location and Details**	**Year**	**SoHIP Project Number**
A	1	1C, 3, 4, 16, 23, 24, 39A, 39B, 39C, 39D, 46, 50	ITS	I-80	Fill in ITS gaps between SR 29 and SR 37 in Vallejo and between Red Top Road and Air Base Parkway.	2015	2
A	2		ITS	I-80	Extend ITS coverage to fill the gap between SR 37 and Red Top Rd	2015	1, 8
A	3	1E, 18, 21, 35, 40, 43, 44, 45, 41, 42, 37A, 37B, 25, 39E, 36A, 36B	ITS	I-80	Extend ITS coverage eastward from Air Base Parkway to the Solano/Yolo County line	2015	3, 17, 18, 22, 23
B	1	34, 26	HOV Lane	I-80	Extend the eastbound HOV-2 lane (between Air Base Parkway and North Texas Street) from North Texas Street to Alamo Drive.	2015	3
B	2	25, 36A, 36B, 39E, 37A, 37B	Ramp Metering	I-80	Implement ramp metering on local service interchanges (eastbound and westbound) between Air Base Parkway and Alamo Drive	2015	3
B	3	7, 9	Auxiliary Lane	I-80	Provide an auxiliary lane in the eastbound direction between Travis Boulevard and Air Base Parkway	2015	4
B	4	25, 37A	Auxiliary Lane	I-80	Provide an eastbound auxiliary lane between Pleasant Valley Road and Alamo Drive with a two-lane off ramp at Alamo Drive	2015	3
C	1	7, 8, 33	Ramp Metering	I-80	Implement ramp metering at the I-80 eastbound Green Valley Road and Suisun Valley Road interchanges	2015	5
C	2		General Purpose Lane	I-80	Provide additional capacity (the equivalent of one, eastbound through lane) at the intersection of SR 12 East and Beck Avenue	2015	7
D	1	3, 23, 24, 39A, 39B, 39C, 39D, 46, 50	Interchange Modifications	I-80	Conduct a comprehensive study to identify and improve geometry and access between SR 29 and SR 37 in both directions by consolidating or removing access points and improving merge and diverge areas	2030	10
D	2	3, 23, 24, 39A, 39B, 39C, 39D, 46, 50	Ramp Metering	I-80	Implement ramp metering in both directions at local access interchanges in Vallejo between SR 29 and SR 37	2030	10

Table 5-3: Comparison of Recommended Projects							
FPI Strategy Package	**FPI Package No.**	**I-80/I-680/I-780 MIS ID**	**Strategy Type**	**Corridor**	**Location and Details**	**Year**	**SoHIP Project Number**
D	3	2, 3, 27, 39A, 39C	HOV Lane	I-80	Extend the WB HOV-3 lane from the Carquinez Bridge to east of the SR 29 westbound on-ramp	2030	10
D	4	24, 32A, 32B, 39B, 46, 50	General Purpose Lane	I-80	Extend the fourth eastbound general purpose lane from the SR 29 off-ramp to the Sequoia Ave off-ramp	2030	11
D	5	24, 32B	Auxiliary Lane	I-80	Provide an eastbound auxiliary lane between the Tennessee St on-ramp and the Redwood St off-ramp	2030	11
D	6	24, 28, 39B	Auxiliary Lane	I-80	Provide an eastbound auxiliary lane between the I-780 on-ramp and the Georgia St off-ramp	2030	11
D	7	23, 39C, 39D	HOV Lane	I-80	Extend the WB HOV-3 lane from east of the SR 29 westbound on-ramp to SR 37	2030	10
E	1	4, 7, 33, 38, 48	Interchange Modifications	I-80	Improve the I-680/I-80 interchange connections to address the capacity deficiencies of these ramps by either modifying the current interchange geometry or implementing an alternative configuration	2030	12
E	2	1F, 8, 6A, 10A, 11A, 33	Auxiliary Lane/ Braided Ramps	I-80	Provide eastbound auxiliary lanes as necessary between I-680 and SR 12 East and adjust truck scales location within the same general area to improve weave and merge maneuvers	2030	Part of EB Truck Scales Project
E	3	7, 17, 33	Auxiliary Lane/ Braided Ramps	I-80	Provide westbound auxiliary lanes and braided ramp configurations as necessary between SR 12 West and I-680, and adjust truck scales location within the same general area to improve weave and merge maneuvers	2030	13
E	4	7, 9, 10B, 12, 17, 33	General Purpose Lane	I-80	Provide additional mainline capacity. The SR 12 West to I-680 should include five general purpose lanes and I-680 to SR 12 East should six general purpose lanes.	2030	13
F	1	7, 9, 10B, 12, 26, 34	General Purpose Lane	I-80	Provide a fifth eastbound general purpose lane extending from SR 12 East to Air Base Parkway while maintaining the existing auxiliary lane between Abenathy Road and West Texas Street.	2030	16

Table 5-3: Comparison of Recommended Projects							
FPI Strategy Package	**FPI Package No.**	**I-80/I-680/I-780 MIS ID**	**Strategy Type**	**Corridor**	**Location and Details**	**Year**	**SoHIP Project Number**
F	2	7, 10B, 12, 34	General Purpose Lane	I-80	Provide a fifth westbound general purpose lane from SR 12 East to West Texas Street.	2030	14
F	3	7, 13B, 34	Auxiliary Lane	I-80	Provide a westbound auxiliary lane between Air Base Parkway and Travis Boulevard	2030	14
F	4	7, 13A, 34	Auxiliary Lane	I-80	Provide a westbound auxiliary lane between North Texas St and Air Base Parkway	2030	15
G	1	41, 42, 43	HOV Lane	I-80	Extend the eastbound HOV-2 lane from Alamo Drive to I-505	2030	17
G	2	41, 42, 43	Ramp Metering	I-80	Implement ramp metering at all eastbound local access interchanges between Alamo Drive and I-505	2030	17
G	3	42, 43	Auxiliary Lane	I-80	Provide an eastbound auxiliary lane between Cliffside Drive and Allison Drive with a two-lane off-ramp at Allison Drive	2030	17
G	4	37A	Auxiliary Lane	I-80	Provide an eastbound auxiliary lane between Cherry Glenn Road and Pleasant Valley Road	2030	17
H	1	18, 25, 36A, 37B, 44, 45	HOV Lane	I-80	Extend the westbound HOV-2 lane from Air Base Parkway to I-505	2030	18
H	2	18, 25, 44, 45	Ramp Metering	I-80	Implement ramp metering at all westbound local access interchanges between Alamo Drive and I-505	2030	17
H	3	25, 37B	Auxiliary Lane	I-80	Provide a westbound auxiliary lane between Alamo Drive and Pleasant Valley Road	2030	18
I	1	40	General Purpose Lane	I-80	Provide a fourth eastbound general purpose lane extending from east of Leisure Town Road to west of SR 113.	2030	22
I	2	35	Ramp Metering	I-80	Implement ramp metering at westbound local access interchanges from I-505 eastward to the Solano/Yolo County line	2030	22
J	1	24, 32A, 32B, 39B, 46, 50	HOV Lane	I-80	Provide an eastbound HOV lane from SR 29 to SR 37	2030	11

Table 5-3: Comparison of Recommended Projects							
FPI Strategy Package	**FPI Package No.**	**I-80/I-680/I-780 MIS ID**	**Strategy Type**	**Corridor**	**Location and Details**	**Year**	**SoHIP Project Number**
J	2		HOV Lane	I-80	Provide an HOV lane in both directions between Red Top Road and SR 37	2030	20, 21
J	3	35	General Purpose Lane	I-80	Provide a fourth westbound general purpose lane between east of Leisure Town Road and west of Kidwell Road	2030	23
		15A, 15B, 48	Ramp Metering	I-680	Implement ramp metering on all NB on-ramps. Where practical, add additional storage and/or through lanes to maximize the efficiency of ramp meters.	2015	6
		15A, 15B, 48	HOV Lane	I-680	Extend the northbound HOV lane through Solano County to the I-80 interchange. Provide a new HOV direct connector from I-680 NB to I-80 EB	2015	6
		15A, 15B, 48	ITS	I-680	Install ITS elements (detectors, CCTV, CMS) on I-680 in both directions	2015	6
		15A, 15B, 48	Ramp Metering	I-680	Implement ramp metering on all SB I-680 on-ramps.	2015	6
		20, 29, 28, 39A	Ramp Metering	I-780	Implement ramp metering at local access interchanges in the eastbound and westbound directions between I-80 and I-680	2030	19
		20, 29, 28, 39A	ITS	I-780	Install ITS elements (detectors, CCTV, CMS) on I-780 in both directions	2030	9, 19
			Auxiliary Lane	I-780	Provide a third westbound general purpose lane between the Glen Cove Road on-ramp and the Cedar Street on-ramp. Connect to the third general purpose starting at the Cedar Street on-ramp.	2030	24
			Auxiliary Lane	I-780	Provide an eastbound auxiliary lane between Spruce Street and Glen Cove Road	2030	25
		29	Auxiliary Lane	I-780	Provide an eastbound auxiliary lane between Columbus Parkway and Military Highway West	2030	26

11. 6. VISUAL DESIGN GUIDELINES

6.1 Introduction – The Process

The project was undertaken over a period of 14 months which included preliminary investigation of the I-80/680/780 Corridors, discussions with the stakeholder jurisdictions along the corridors, inventory and analysis of existing conditions, synthesis of alternative design themes, and finally the production of the Visual Design Guidelines. A sub-committee was asked to participate in a series of meetings to review the design as it progressed. The sub-committee was made up of representatives of the stakeholder jurisdictions along the corridor and other interested and governing bodies including:

- City of Benicia
- City of Dixon
- City of Fairfield
- City of Vacaville
- City of Vallejo – did not attend but has been kept informed
- County of Solano
- Caltrans District 4
- California Center for Urban Horticulture, University of California, Davis
- Sacramento Area Council of Governments
- Metropolitan Transportation Commission

6.2 The Purpose of the Visual Design Guidelines

These visual design guidelines are intended as a guide for use by the Cities along the corridor and engineering/design consultants responsible for preparing visual and aesthetic treatments along the corridors. The guidelines provide direction to design efforts so that the corridors maintain a strong sense of identity and character throughout phased development of construction projects. The guidelines are not intended as specifications therefore state and local codes and standards shall be followed by the designers.

6.3 Goals and Objectives

Goals are broad recommendations that form the baseline for the design theme. Objectives refine the intent of goals by making specific recommendations. Together they help guide the design effort. The goals for the I-80/680/780 Corridor Design are:

- Develop a cohesive landscape and hardscape program for the entire project area
- Develop a gateway, landscape and hardscape palette that is unique and expresses the identity of each city, yet fits into the overall program
- Create a landscape and hardscape program using sustainable, environmentally friendly and maintenance friendly plants and materials

The design theme for the corridor, led by these goals, helps to enhance and strengthen visual and aesthetic relationships between the corridor and surrounding areas. Implementation of the theme involves translating the goals into specific actions and designs:

- Develop a cohesive landscape and hardscape program for the entire project area:
  - Through the use of a strong landscape and hardscape scheme as a common thread throughout.
  - By repetition of forms, colors, textures and materials within chosen elements:
    - Retaining Walls
    - Sound Walls
    - Underpass Treatments and Abutments
    - Structure Treatments – Supports and Railings
    - Median Divider
    - Poured In Place Contrasting Surfacing
    - Highway Signage Support Structure

- Develop a gateway, landscape and hardscape palette that is unique and expresses the identity of each city, yet fits into the overall program:
  - By creating gateway monuments that have common elements such as planting and hardscape while allowing for each city to have its own design within the common elements.

- Create a landscape program using sustainable, environmentally friendly and maintenance friendly plants and materials:
  - By using drought-tolerant, pest and disease resistant plant material that is long lived and requires no or low maintenance
  - By using low water, state of the art irrigation systems
  - By using weed control mulch in planted areas

6.4 The Design Themes

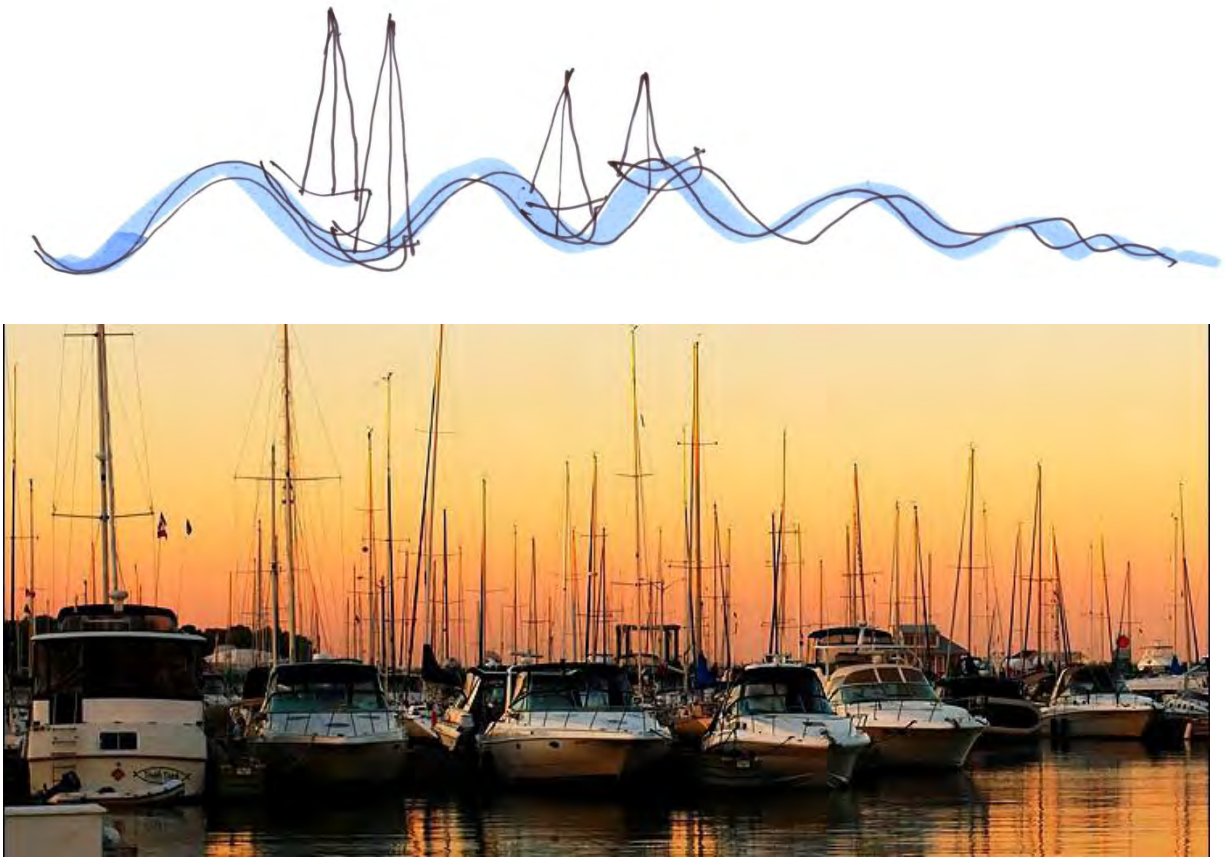
The design theme for the I-80/680/780 Corridor emphasizes strong planting schemes along the edges of the travel way as a unifying element and accents entry points to each City with gateway signage, overpass signage and/or special planting. The planting schemes alongside the travel lanes reinforce the scale and feeling of the surrounding landscape. Repetition of colors, shapes, materials, textures, key plants and site improvements within each theme further enrich the design. Each of the three planting themes and design elements are outlined below.

For planning and design purposes, the project has been divided into three landscape themes; nautical, agricultural and naturalistic. Within each area and jurisdiction, gateway locations have been identified along with identity colors for each jurisdiction that will be applied to site improvements.

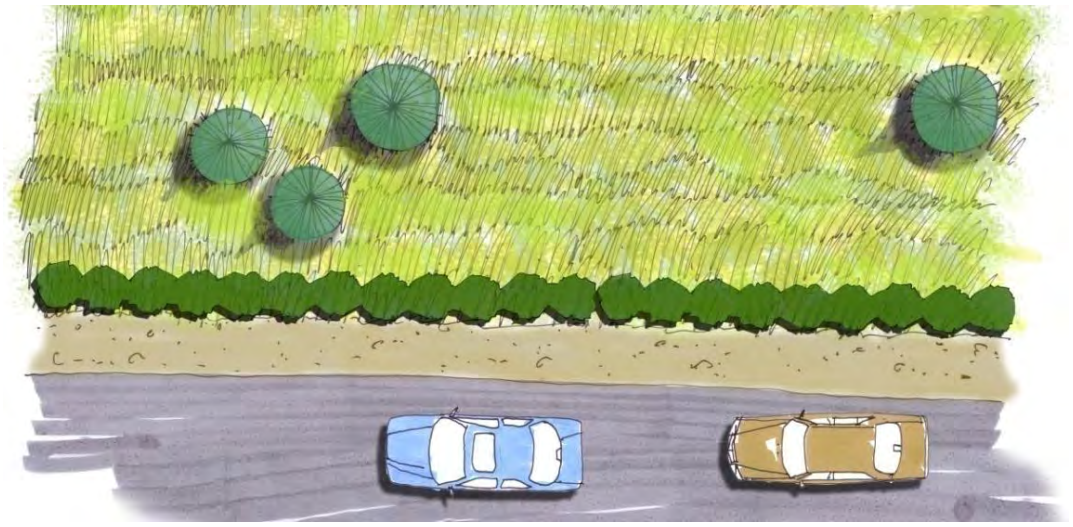
6.4.1 Nautical Theme

The nautical theme is inspired by the ocean and the patterns ships make in the water. Undulating grasses and drifts of soft branched shrubs represent ocean waves. The 'waves' are interrupted by triangular conifer trees resembling the pointed sails of boats and ships. The grasses and shrubs are slightly monochromatic in color and change with the season from grey, yellow and/or green or by fall or flower color. The planting scheme will be complimented by gateway signage and treatments that reflect the rich nautical history of both Vallejo, Benicia and Solano County.

- The nautical theme is carried through Vallejo and Benicia.
- The nautical planting scheme is inspired by the ocean and the patterns ships make in the water. Undulating grasses and drifts of soft branched shrubs represent ocean waves. The plants vary in texture, color and height.
- The 'waves' are interrupted by triangular conifer trees (ships). The grasses or shrubs are slightly monotone in color and change with the season from grey, yellow and/or green or by fall or flower color.
- The plant selection criteria is defined by specific requirements such as:
  - Low maintenance and water usage
  - Drought tolerant
  - Seasonal color
  - Disease and pest resistance



Nautical Theme Inspiration Images



Nautical Theme Plan, Elevation and Section Illustrate Inspirational Images

Nautical Theme - Plant Examples

Ship masts in the ocean/conifers set in undulating grasses/shrubs



- Tree species examples suggested for achieving the nautical look of masts and sails:
  - *Calocedrus decurrens*, Incense Cedar
  - *Cedrus atlantica*, Atlas Cedar
  - *Cedrus deodara*, Deodar Cedar

- Shrub, ground cover and grass examples suggested for achieving the nautical look of water and waves:
  - *Coleonema sp.,* Breath of Heaven
  - *Leptospermum sp.,* Tea Tree
  - *Miscanthus sp.,* Maidenhair Grass
  - *Carex sp.,* Sedge



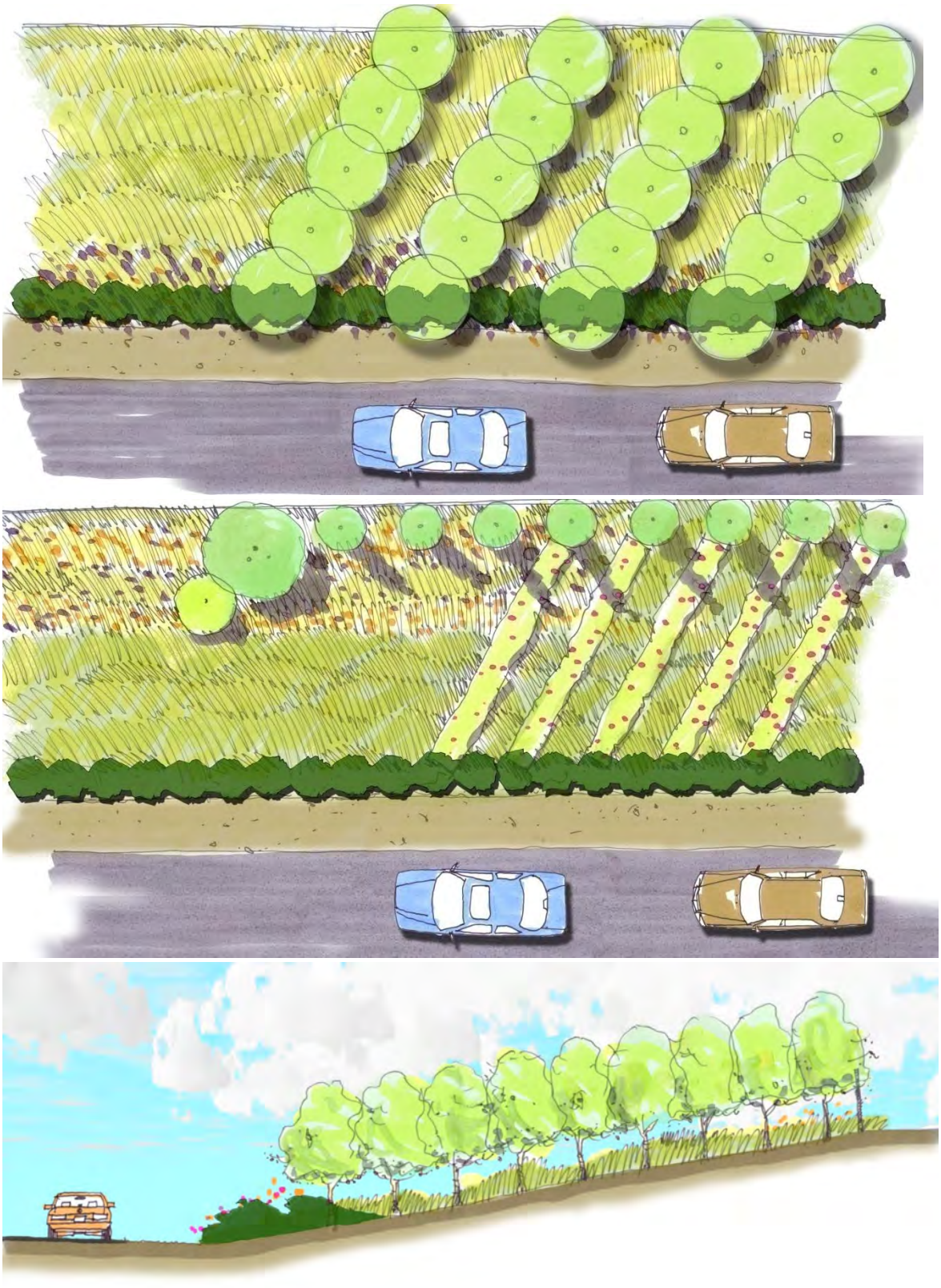
6.4.2 Agricultural Theme

The agricultural theme is inspired by the fields of crops and orchards along the Solano corridor. An orchard effect is represented using multiple lines of colorful hedges and flowering trees. Linear patterns of plantings are meant to not only mimic the nearby fruit and vegetable fields, but the tree rows also act as a wind break and visual barrier. The majority of the ground cover planting is of a neutral palette. In specific locations throughout the corridor, accent plantings in a linear pattern with seasonal color can be applied. The planting scheme will be complimented by gateway signage and treatments that reflect the agricultural roots in Dixon, Vacaville, Fairfield and Solano County.

Agricultural Theme - Planting Scheme

- The agricultural planting scheme is inspired by the fields of crops along the Solano corridor.
- An orchard effect is designed using multiple lines of colorful hedges and flowering trees. These linear patterns of plantings are meant to not only mimic the nearby fruit and vegetable fields, but the tree rows can act as a wind break and visual barrier.
- The majority of the ground cover planting is of a neutral palette. In specific locations throughout the corridor, accent plantings in a linear pattern with seasonal color can be applied.

Agricultural Theme Inspiration Images



Agricultural Theme Plans and Section Illustrate Inspirational Images

Agricultural Theme - Plant Examples

Rows of colorful hedges mimicking orchards

- Trees for achieving an agricultural look:
  - Populus nigra, Lombardy Poplar
  - Pistachia chinensis, Chinese Pistache
  - Pyrus species, Flowering Pear
  - Malus species, Flowering Crabapple



- Shrub, ground cover and grass examples suggested for achieving the agricultural look of orchards and crops in the field:
  - Quercus sp., Oaks
  - Schinus molle, California Pepper Tree
  - Arbutus unedo, Strawberry Tree
  - Heteromeles arbutifolia, Toyon



6.4.3 Naturalistic Theme

The naturalistic planting scheme is inspired by the native hillside landscape along the Solano corridor. A naturalistic arrangement of planting brings the hillside aesthetic to the road edge using native trees, shrubs, ground covers, wildflowers and grasses. The majority of the ground cover planting is of a neutral palette of drifts of native plants. The naturalistic theme is carried throughout unincorporated areas and in between the gateway landscaping locations in all jurisdictions along the corridors.

Naturalistic Theme - Planting Scheme

- The naturalistic theme is carried throughout unincorporated areas and in various locations in all jurisdictions along the corridors.
- The naturalistic planting scheme is inspired by the native hillside landscape along the Solano corridor.
- A naturalistic arrangement of planting brings the native landscape look to the road edge using native trees, shrubs, ground covers, wildflowers and grasses.
- The majority of the ground cover planting is of a neutral palette of drifts of native plants.

Naturalistic Theme Inspiration Images

Naturalistic Theme - Plant Examples

Flows of native plants reflecting the natural hillside landscape

- Trees and shrubs for achieving an agricultural look
  - Aesculus californica, California Buckeye
  - Platanus racemosa, California Sycamore
  - Populus species, Poplar
  - Quercus species, Oak

- Shrubs and ground covers for naturalization
  - Arctostaphylos sp., Manzanita
  - Ceanothus sp., California Wild Lilac
  - Cephalanthus occidentalis, Button Bush
  - Eriogonum sp., California Buckwheat
  - Heteromeles arbutifolia, Toyon
  - Rhamnus sp., Coffeeberry
- Sambucus sp., Elderberry

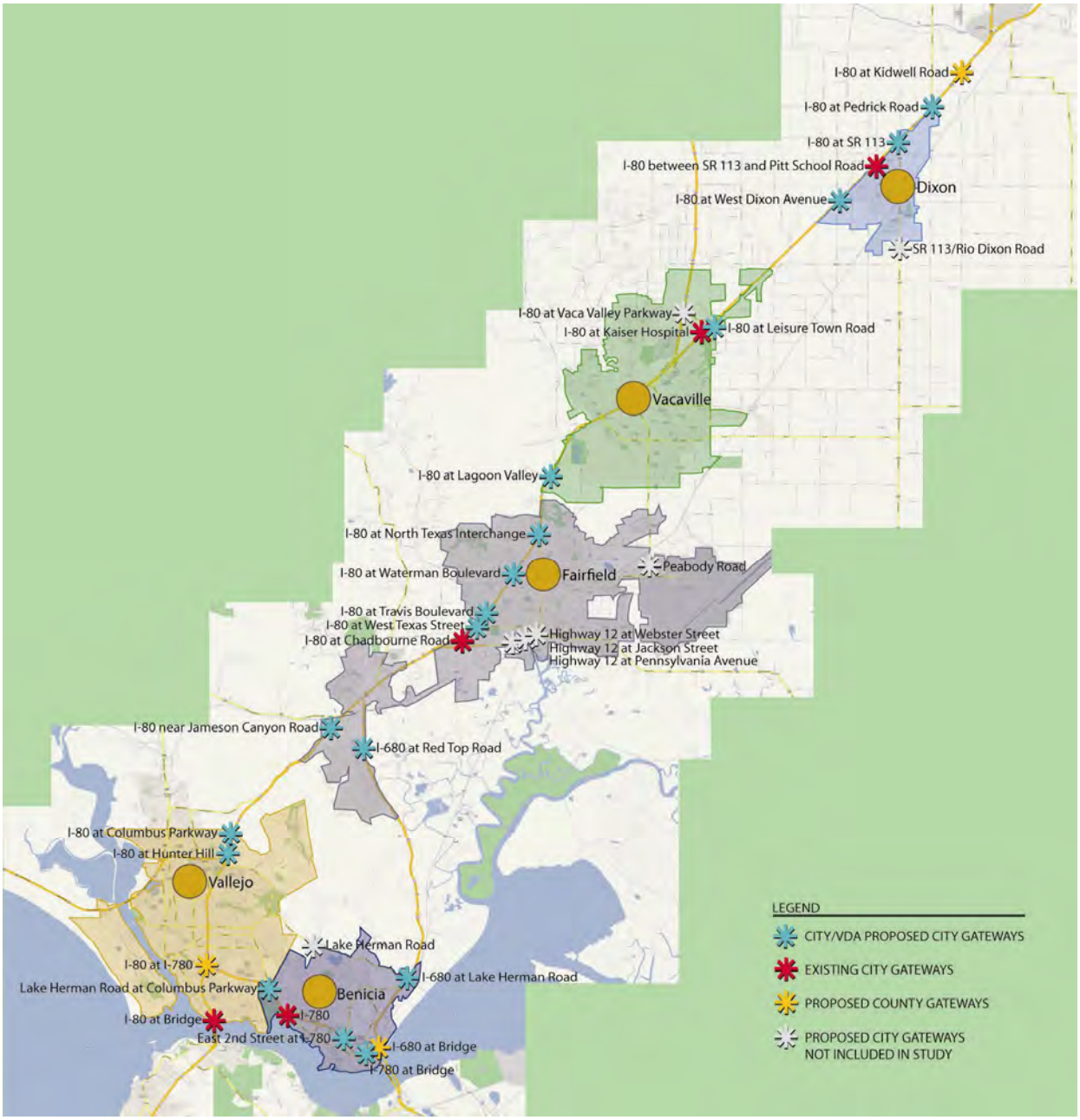
6.5 Identity Colors

From each existing logo, an "identity color" was presented to help define each city along the corridor. This color scheme will assist in unifying the corridor and will be used in the gateway treatments, the overpasses and possibly

on the sound walls. This grouping of colors, the gateways and the plant palette are to help establish an identity for the Solano Corridor.

6.6 Gateways

The design of the landscape and other design elements will create a continuous impression throughout the I-80/680/780 Corridors. Again, repetition of colors, shapes, materials, textures, key plants and site improvements within each theme will create accents at gateway locations while relating to each other to create a cohesive impression along the interstates. Each gateway location highlights a city's entry point and unique plantings are used to accent main points of interest in each city along the interstate. In many locations, a city identification sign accompanies the unique planting scheme.

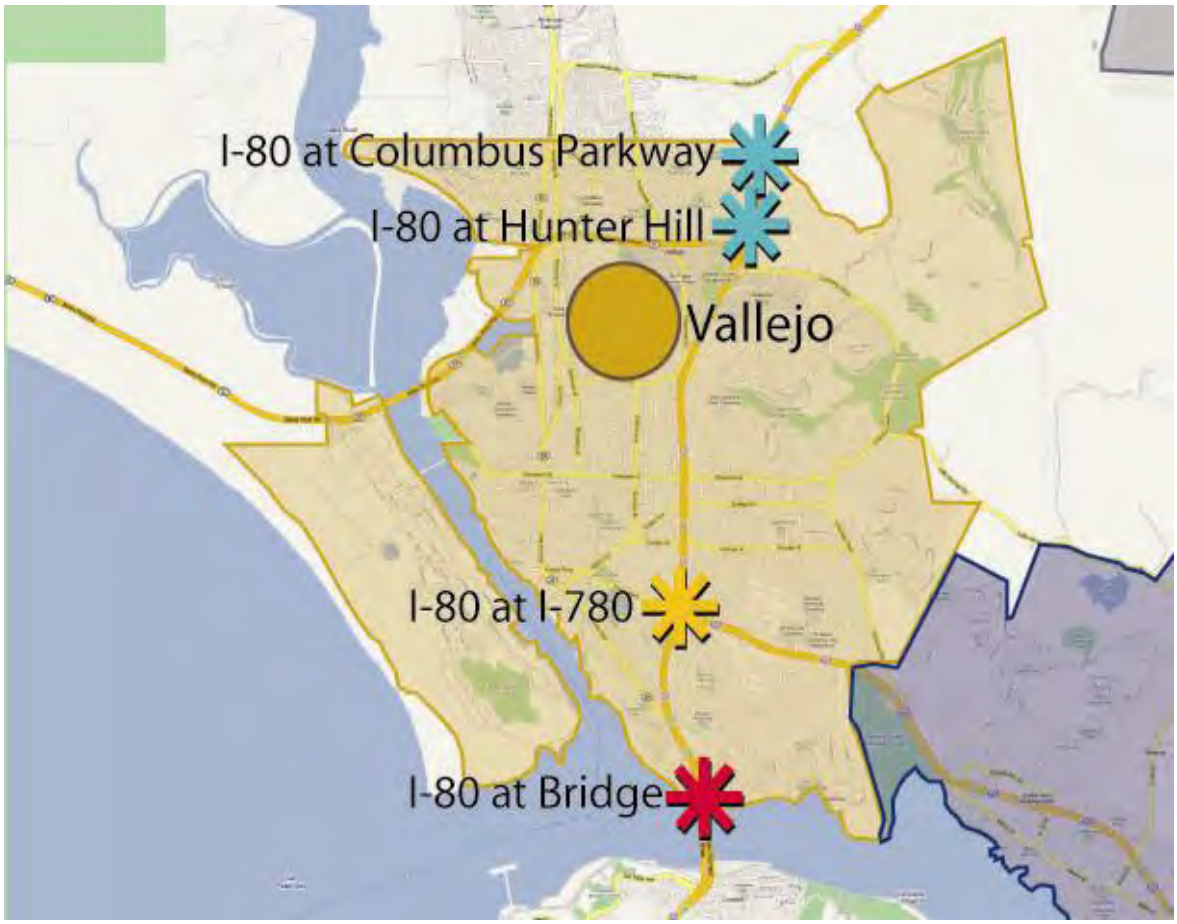


Solano County Overall Gateways Map

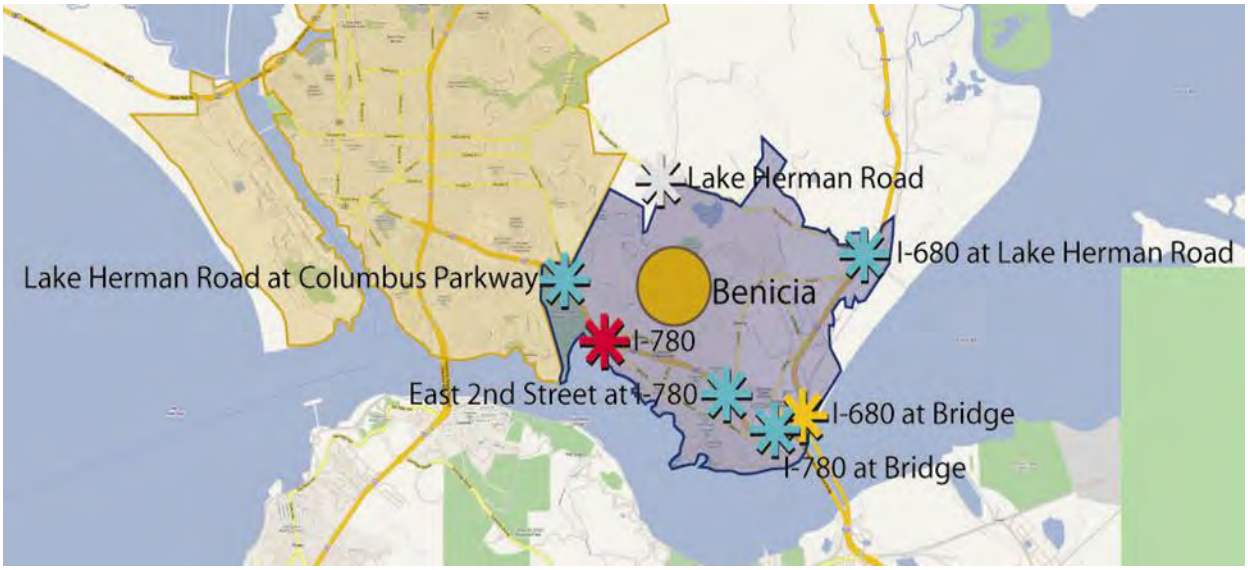
The gateways are thematic and relate to the city's regional location. The gateway designs are based on the nautical, agriculture and naturalized landscape themes. Each gateway sign is to have a repeating element of a stacked stone wall which will act as the base of each city's sign. The proposed gateways are to integrate with the previously designed Fairfield gateway.

The overall structure height is approximately 12'-0" so that it may be seen from the interstate by drivers. The overall structure width is approximately 25'-0". The size of the gateway sign is to be large enough to be seen from highway distances but not be intrusive or distracting to highway drivers. Each jurisdiction's gateway is highlighted with its own unique planting scheme that is reflective of one of the three themes. The plant palettes vary in texture, height, and color. Lower growing plantings are proposed in the foreground of the gateways and are approximately 2'-0" tall. These lower plantings are also present at the county gateway. Use common historic or themed elements unique to each municipality. Use natural or indigenous materials. Uplights may be added to further emphasize the gateways details.

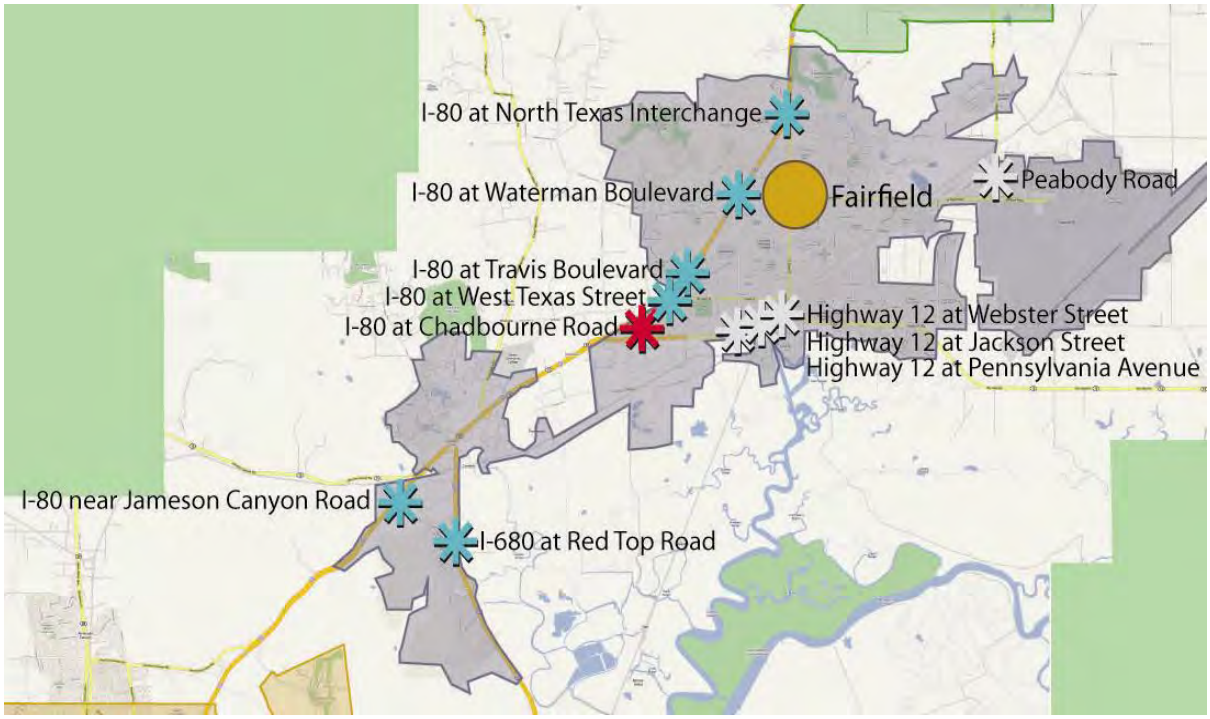
The gateway treatments are not allowed on Caltrans right-of way so the City gateways will occur on City property outside the Caltrans right-of way unless an agreement with Caltrans is reached. All gateway locations are to be approved by the jurisdictions' boards and commissions.



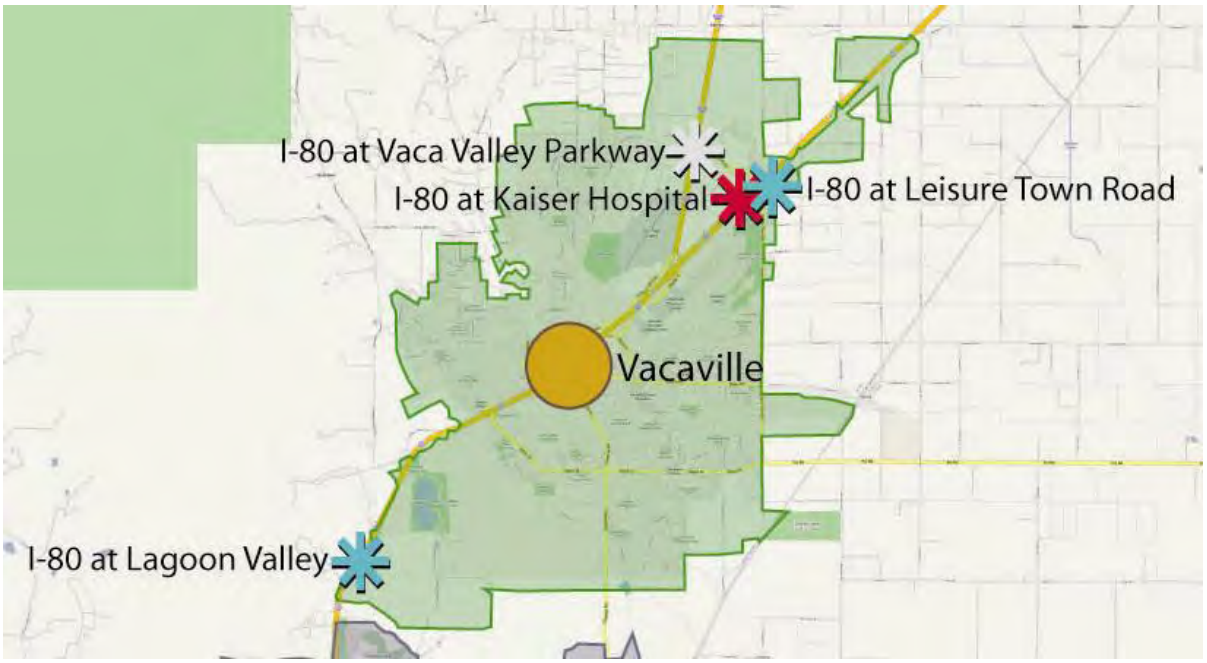
Vallejo Gateways Location Map



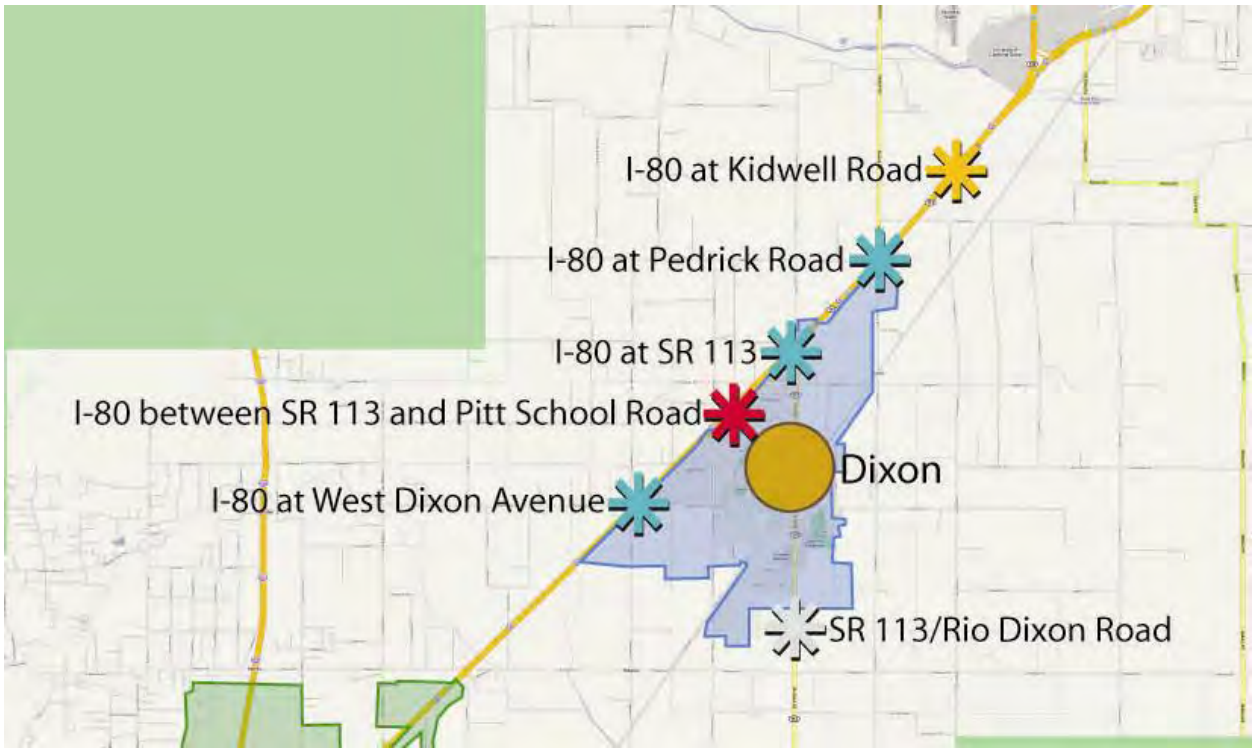
Benicia Gateway Location Plan



Fairfield Gateway Location Plan



Vacaville Gateway Location Plan

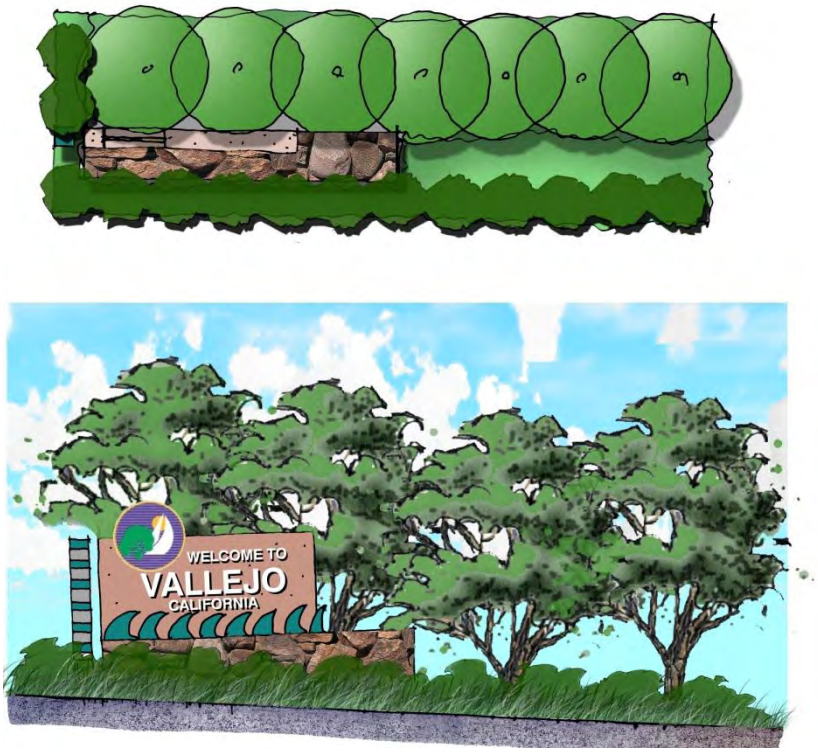


Dixon Gateway Location Plan

6.6.1 Nautical Gateway

- The nautical theme is carried through Benicia and Vallejo.
- Accent bands or designs illustrate the City's identity color.

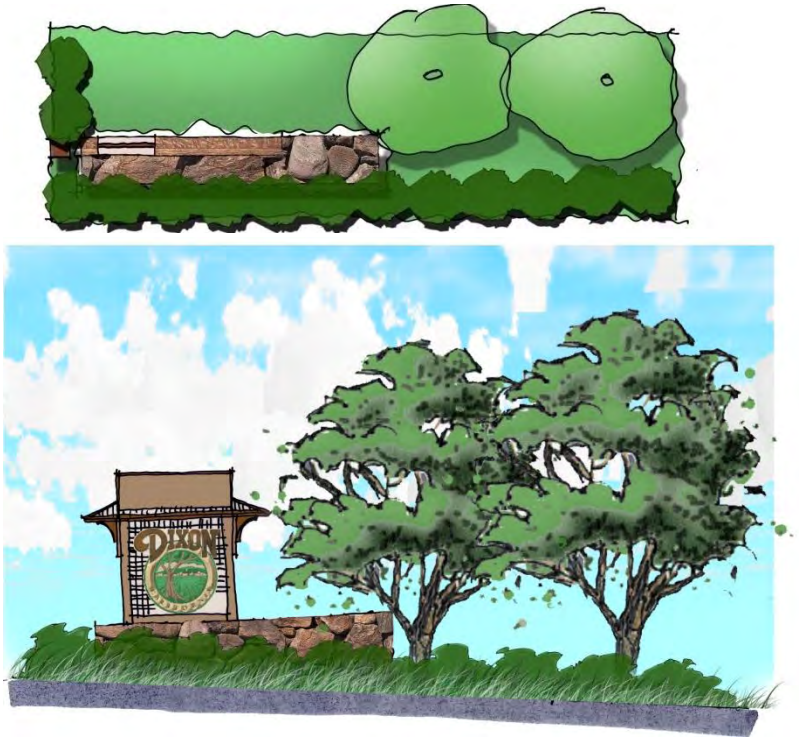
Benicia Gateway Conceptual Plan and Elevation



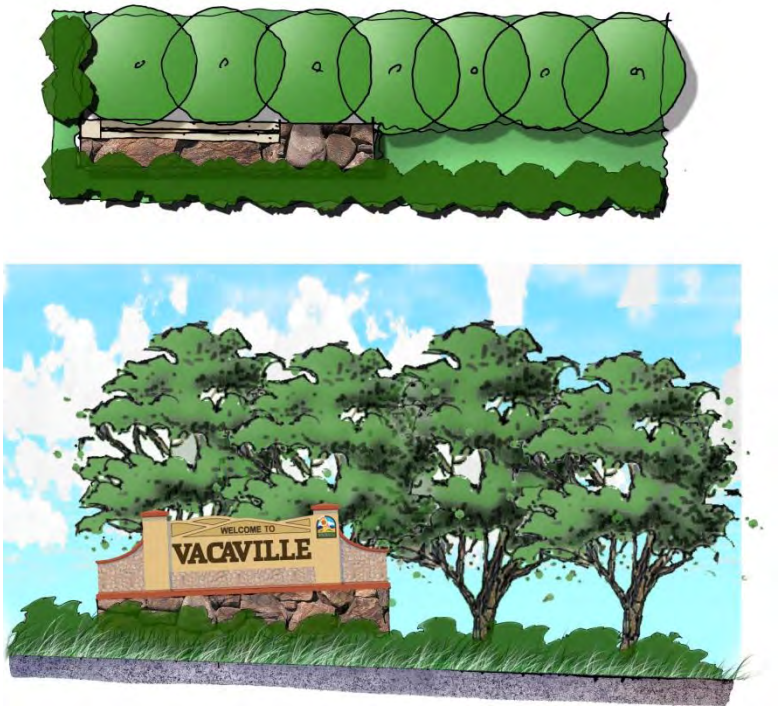
Vallejo Gateway Conceptual Plan and Elevation

6.6.2 Agricultural Gateways

- The agricultural theme is carried through Dixon and Vacaville.
- The agricultural themed gateways have a similar layout to the nautical themed gateways but differ due to variation in the planting palette and pattern.



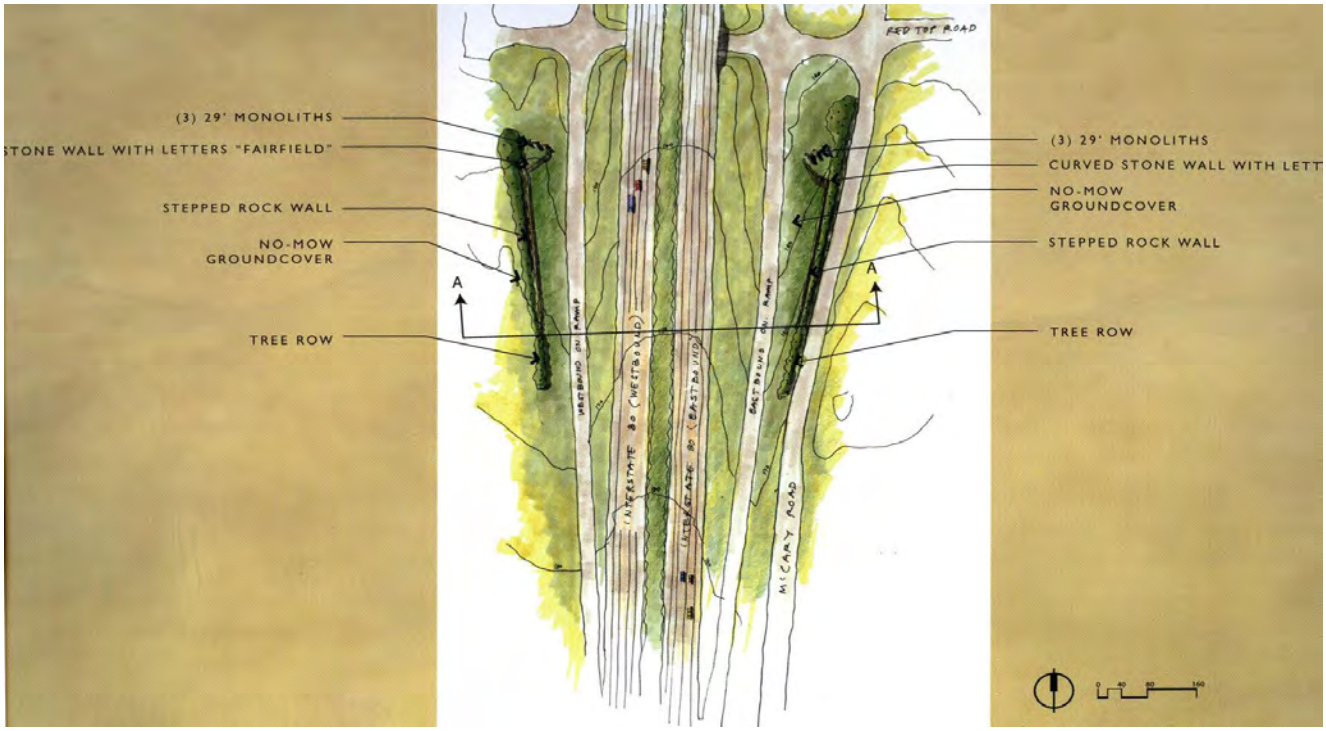
Dixon Gateway Conceptual Plan and Elevation

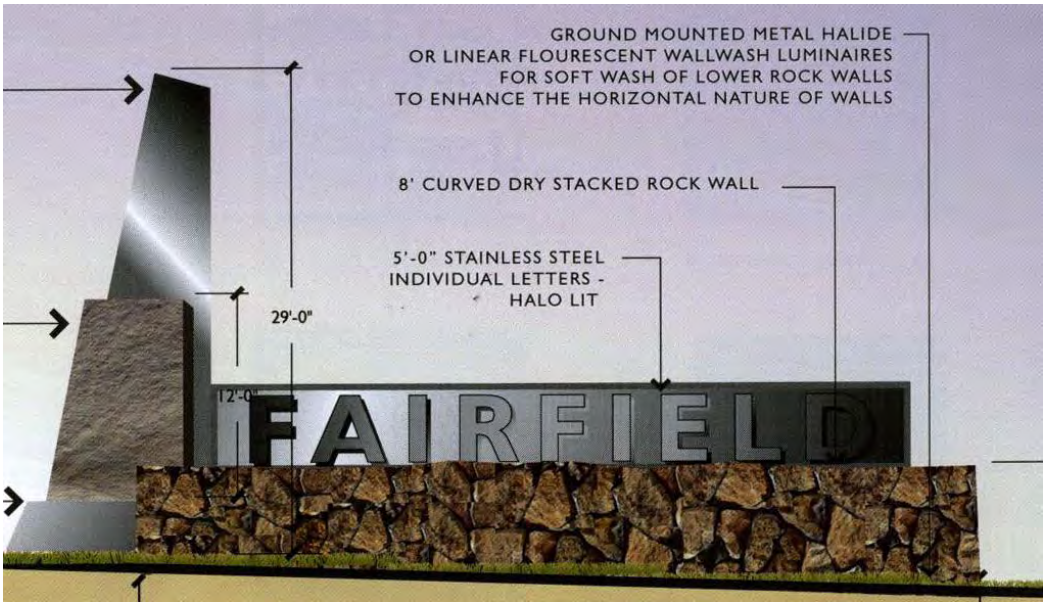


Vacaville Gateway Conceptual Plan and Elevation

6.6.3 Solano County and Fairfield Gateways

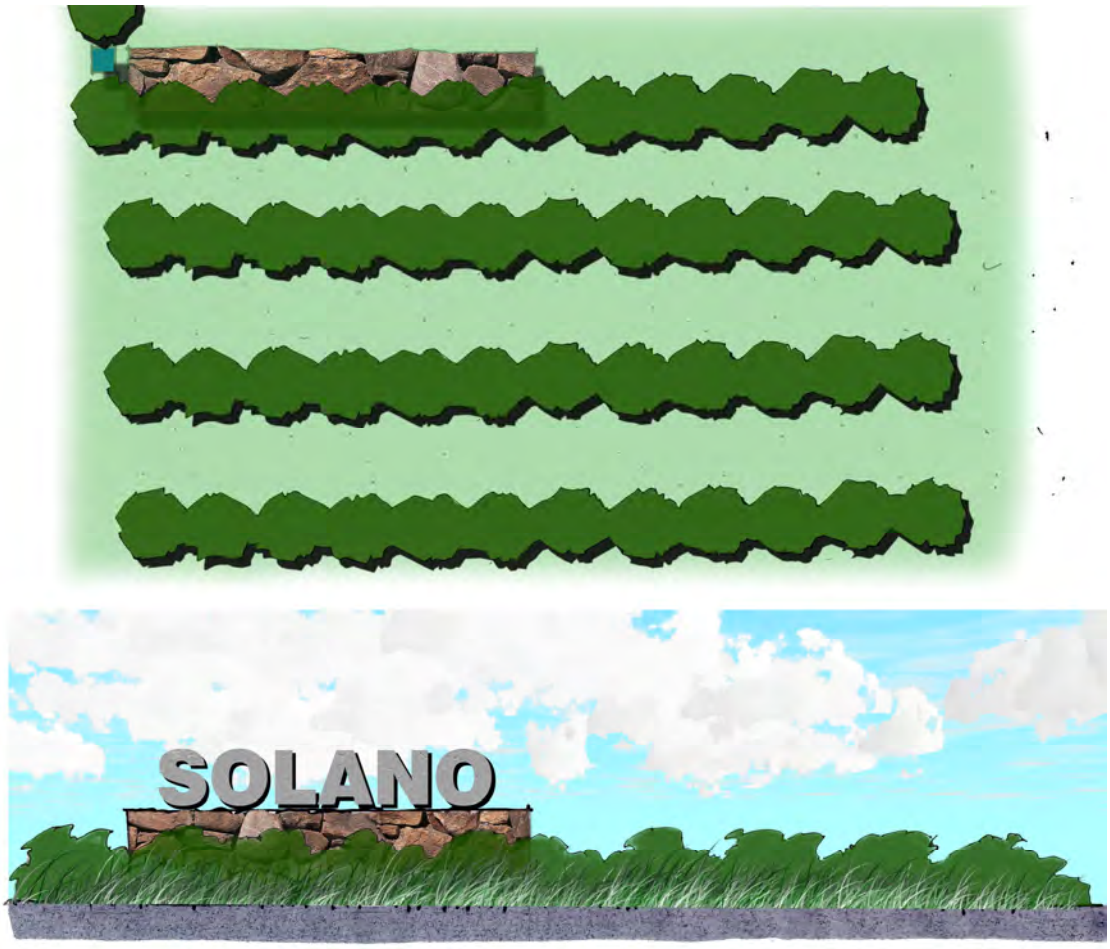
- The Solano County and Fairfield gateway are a combination of the nautical and agricultural themes. The Solano County gateway uses the stone wall, agricultural orchard planting and the nautical post with all the jurisdictional colors on it and metal cut out letters. The Fairfield gateway has an aeronautical theme with agricultural hedgerows planted in association with the gateway feature.





Fairfield Gateway

Conceptual Plan and Elevation



Solano County Gateway Conceptual Plan and Elevation

6.7 Overpass Gateway Treatment

- For each municipality's overpass treatment, their identity color will be applied as an accent band on the face of the overpass. The stripe is meant to compliment the color used on the gateway signage.
- Each municipality's logo is to be applied to the existing or new overpass abutment.
- As drivers approach the overpass, the planting along the highway will become more detailed to highlight the overpass treatments. The planting at the base of the abutments reflects the municipality's theme and is to be rich in color, pattern and texture.

Vallejo Overpass Gateway Treatment

6.7.1 Design Elements

Several elements occur within the I-80/680/780 Corridor that contribute to the overall themes and create a unified image. These elements become a readable visual sequence along the corridor and helps create a coherent image and identity for motorists.

This section outlines the recommended treatment of each element to be incorporated into the design of the I-80/680/780 Corridor. Consultant engineers and designers responsible for design and construction documents for the corridor should consult these guidelines for the recommended treatment of each element. Design elements include:

- Retaining Walls
- Sound Walls
- Underpass Treatments and Abutments
- Structure Treatments – Supports and Railings
- Median Divider
- Poured In Place Contrasting Surfacing

- Highway Signage Support Structure

6.7.2 Retaining Walls

Retaining walls are used to minimize grade or elevation changes that occur along the roadway. The There will be two options for retaining walls:

- Cast in place concrete with typical panel of a fractured fin texture with a recessed accent band at the top of the wall or minimal design that is reflective of a community element such as the wall in Benicia
- Custom stamped design in retaining wall such as the walls in Vacaville

Construction methods for retaining walls will consist of cast in place concrete using precast panels, either the standard 'fractured fin' panel or a decorative custom panel that is designed, prepared and installed through agreement between Caltrans and the City the wall is located in. The use of architectural treatments like the fractured fin precast panels with smooth accent band at the top of the wall will provide visual continuity with other structures such as sound walls, bridge supports and abutment treatments by repetition of textures and forms. The goal of retaining walls is to minimize steep slopes and the walls should provide visual continuity along the corridor and provide architectural detail to the wall to break up the mass and visual starkness of a large vertical concrete surface. The base of retaining walls adjacent to the shoulder of the road way along the travel way will have a concrete barrier at the base. If space is available, the walls should be broken up by using two shorter walls rather than one tall wall. In order to reduce construction costs minimize the bulk and height of walls by maximizing the slope of landscape areas at a maximum of 3:1 slope. Additional mitigation for walls is to allow landscape to soften the walls using overhanging plants and vines and using gradual stepped transitions in height. Landscape will also minimize the likelihood and lessen the appearance of graffiti.

6.7.3 Sound Walls

Sound walls are used adjacent to areas to mitigate noise and the visual impacts of the roadway. The height of the wall is calculated by the amount of sound generated by traffic on the roadway. There are two types that exist along the corridor. We have selected one of the two to be the design for all new walls along the corridor:

Sound Wall Treatment

The wall is grey with split face block face and cap accented with two rows of blocks that protrude from the face of the wall every other block to make a dashed pattern at the top of the wall in the third and fifth row from the top. There is a smooth face block band below the cap block and each jurisdiction may paint the surface with their signature color to identify the area as being part of the City.

New sound walls should be configured in straight lines where possible and stepped down at the ends in 5'-0" wide minimum intervals by at least one block at a time. As with the retaining wall, the base of sound walls adjacent to the shoulder of the road way along the travel way will have a concrete barrier at the base as shown in the photo. The proposed color will match the existing wall. Wall height will vary based on sound calculations as will the size of the blocks which is dependent on the wall height. The split face cap block will be either 10" or 12" deep by 8" tall by 16" wide and will have a solid or grouted top to seal the top of wall. The split face block used for the body of the wall will be either 6" or 8" deep by 8" tall and 16" wide as will the smooth band block. The dash blocks will be either 10" or 12" deep by 8" tall by 16" wide. Vine holes may be present in the walls by either leaving a block out or by drilling a circular hole in the wall at 20'-0" intervals. Vines will soften the appearance of the walls and minimize the likelihood and lessen the appearance of graffiti.

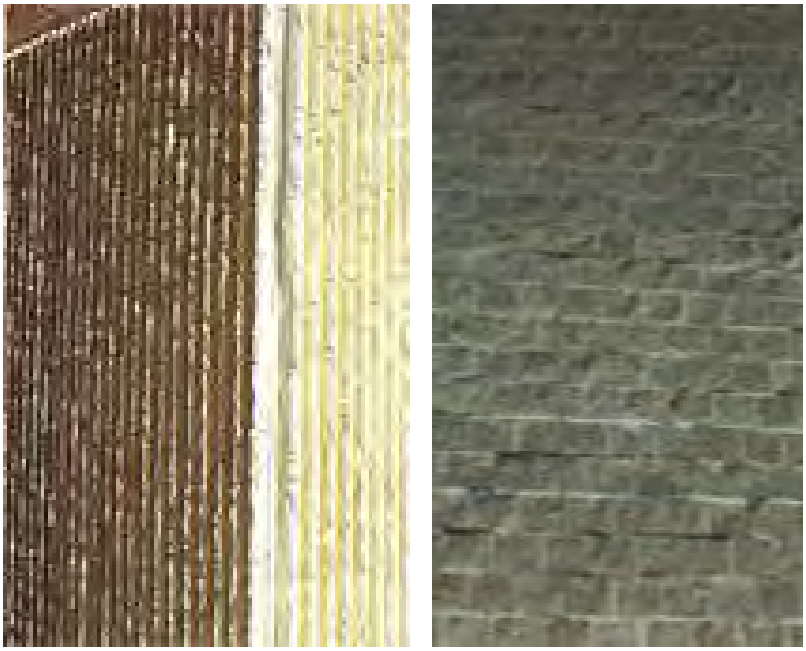
6.7.4 Underpass Treatments

Where the interstate crosses under a local street an overpass is constructed. The area under the overpass has abutments and side slopes to take up the grade at each side of the roadway. Typically the underpass treatments of the sloped paving throughout each municipality are to match the sound walls found along the Solano corridor. Concrete blocks (CMU) are to be used where applicable to stabilize the slope and eliminate the landscape or lack thereof under the bridges.

Underpass Treatment

The split face texture will be surrounded by smooth concrete banding on all sides. Alternate treatment for the sloped paving may include artistic relief sculptures or designs for jurisdictional identity and enhancement. This would be done through special agreements with Caltrans.

The bridge abutment of the underpass when new will have the 'fractured fin' texture or the split face texture to match the retaining and sound walls. The fractured fin pattern is a standard Caltrans with a vertical pattern with ¾" relief. The color will match the sound walls and will be surrounded by smooth bands of concrete on all sides.



Fractured Fin and Split Face Concrete Underpass Treatments

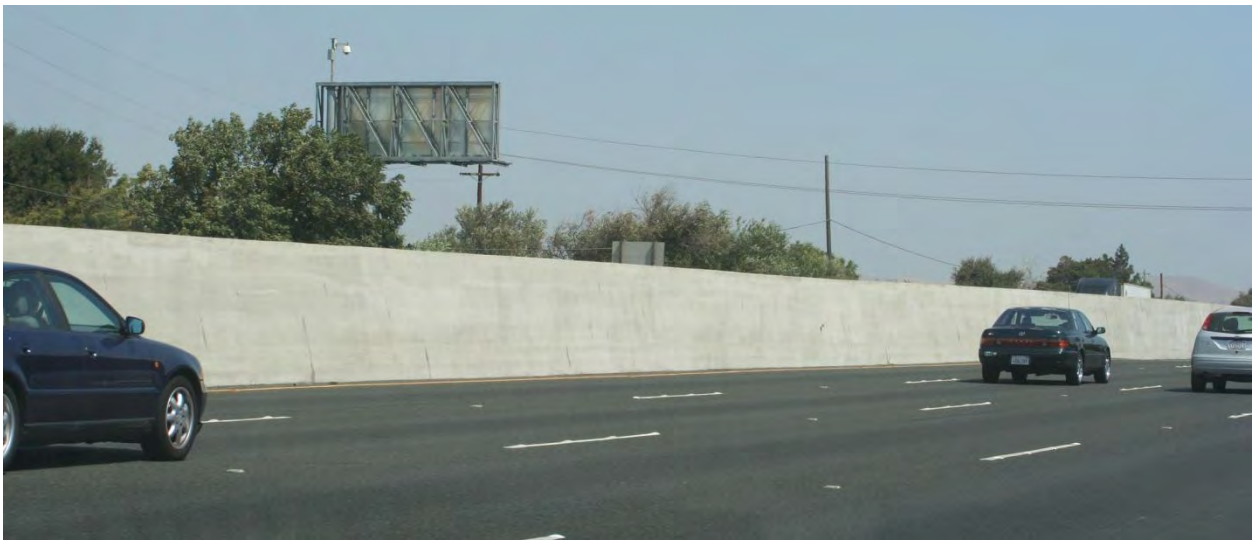
6.7.5 Structure Treatments – Supports and Railings

Consistent treatment of overpasses, underpasses and crossings reinforce the I-80/680/780 Corridor theme. Typical new structures should be the same and are natural colored concrete with split face or fractured fin accents consistent with the retaining and sound wall treatments, which further strengthens the relationship between individual elements and the overall themes. The fractured fin pattern is a standard vertical ribbed pattern with ¾" relief. All structures shall have a smooth accent band running the length of the bridge parapet to allow for the application of identity colors. The pier column is to have rounded edges with an inset fractured fin accent band in the centre of the column on both sides.

Bridge Structure Treatment

6.7.6 Median Divider

- The median divider separates traffic recommended throughout the corridor is a solid concrete barrier in natural colored concrete. The design height will differ depending on site conditions but at a minimum will be the standard height of 42" tall.



Median Divider Treatment – Structure is taller than normal due to elevated roadway in the opposite direction.

6.7.7 Poured-In-Place Contrasting Surfacing

Contrasting surfacing is located at the nosing of off ramps in areas that are too small to landscape efficiently and are unsafe to maintain. In lieu of landscaping, concrete or other hardscape surfacing is installed in the nosing. The contracting surfacing recommended for the I-80/680/780 Corridor is to be poured-in-place, natural colored, stamped concrete in a split face paver pattern of running bond with no more than ½" change in surface. The contrasting surfacing pattern compliments the designs of the retaining walls, sound walls, overpass and structure treatments.

Poured-in-Place Contrasting Surfacing Treatment

6.7.9 Highway Signage Support Structure

Highway signage support structures hold directional and informational signage pertinent to the driver. The recommended structure is the "arc type" and should be used for new and replacement structures as improvements occur so that within 15-20 years signage structures will be unified along the study corridor.

Highway Signage Support Structure Treatment

12. 7. PUBLIC OUTREACH PLAN

The outreach plan purpose is to identify the process and materials to inform, educate and solicit input from stakeholders beyond the Solano Highways Partnership (SoHIP) on the operational improvements that could be implemented along the corridors.

The target audience includes the traveling public who use the I-80/680/780 Corridors as well as the residents, staff (non-SoHIP members) and elected officials from the jurisdictions adjacent to the corridors.

7.1 Public Outreach strategies

7.1.1 Information/Education Tools

To provide a rich educational and informative reference on the various operational improvements that will be considered, an "operations improvement tool box" was developed. This toolbox provides a menu of operational improvements considered and/or recommended for the freeway corridors. In addition, fact sheets were developed for ITS management strategies that include a description of the improvement, a brief synopsis of the pros and cons, identification of the benefits, application of the improvement in other areas of California and the US with specific emphasis on areas similar to study area corridors.

Toolbox

The toolbox is designed to be an interactive tool that works hand in hand with the fact sheets. The types of operational improvements that are part of the toolbox include:

OPERATIONAL IMPROVEMENTS

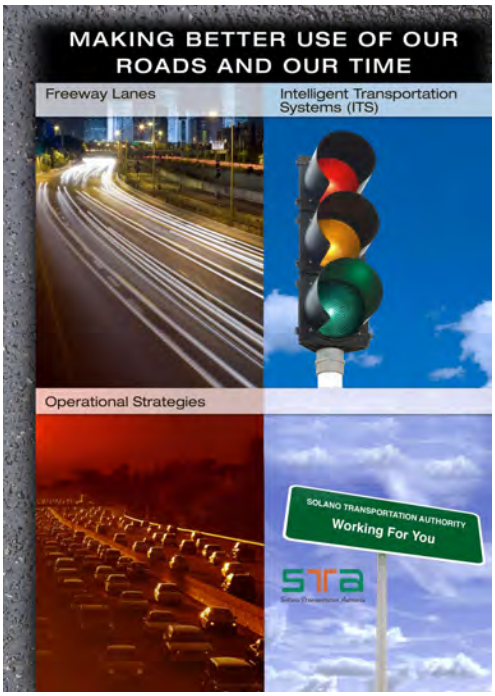
- HOV lanes
- Auxiliary lanes
- Truck climbing lane

INTELLIGENT TRANSPORTATION SYSTEMS (ITS)

- Ramp Meters
- Closed Circuit Television (CCTV) cameras
- Vehicle Detection Systems (VDS)
- Changeable Message Signs (CMS)
- Highway Advisory Radio (HAR)
- Communications Network

OPERATIONAL STRATEGIES

- Traffic Incident Management
- Emergency Management
- Active Traffic Management
- Diversion Management
- Lane Management
- Speed Harmonization – Variable Speed Limits
- Adaptive Ramp Metering
- Express Lanes (High Occupancy Toll or HOT Lanes)



The toolbox being an interactive tool will enable the STA to post it on the STA website and can also be provided to other agencies for posting on their websites and other public postings.

Fact Sheets

The purpose of the fact sheets is to provide brief summary material on the key ITS strategies. The intended audience includes the public and other non-technical readers who want more information on what these types of system management strategies are. The fact sheets provide valuable information on what the Solano Transportation Authority can use in its system management set of strategies to manage congestion.