STATE ROUTE 4 AND STATE ROUTE 242 RAMP METERING STUDY AND IMPLEMENTATION PLAN - FINAL

December 2012

Prepared by:

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Atkins

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December 26, 2012 Project #: 170640

Ms. Joy Lee and Mr. Raymond Odunlami
Metropolitan Transportation Commission
101 Eighth Street
Oakland, CA 94607

Mr. Alan Chow
Caltrans District 4
Office of Traffic Systems, Mail Station 5F
111 Grand Ave
Oakland, CA 94612

RE: Contra Costa State Route 4 and State Route 242 Ramp Metering Study Deliverable 3.3D – Final Ramp Metering Feasibility and Implementation Plan

Dear Ms. Lee, Mr. Odunlami, and Mr. Chow:

Kittelson & Associates, Inc. (KAI) is pleased to submit this final report in support of the State Route 4 and State Route 242 ramp metering study. This report is Deliverable 3.3D of the project.

This report was produced in association with Mohan Garakhalli of Atkins who provided existing and 2015 baseline information for the SR 4 corridor.

We would like to give credit to several engineers and planners at KAI who contributed greatly to this effort: Allen Huang, Lillian Tsang, Neelita Mopati, Ganesh Karkee, and Jorge Barrios.

Please call me at 510-839-1742 x120 if you have any questions.

Sincerely,
KITTELSON & ASSOCIATES, INC.

Rick Dowling, PhD, PE
Senior Principal Engineer

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Associate Engineer

TABLE OF CONTENTS

1. Executive Summary 1
2. Introduction 4
2.1. Definition of Existing Conditions 4
2.2. Study Area 6
3. Study Approach 11
3.1. TRAVEL DEMAND FORECASTING METHODOLOGY 11
3.2. Recommended Analysis Time Periods 11
3.3. Existing Data Sources 11
3.4. TRAFFIC OPERATIONS ANALYSIS Methodologies And 12
3.5. Future Projects in Year 2015 and Year 2030 in the study area 13
4. Existing Conditions 16
4.1. State Route 4 Existing Conditions 16
4.2. State Route 242 Existing Conditions 31
4.3. Analysis of Other freeways, Arterials, and Intersections 33
5. Future Baseline Travel Forecast and Trends 44
5.1. Mobilitiy Trends in Study Area 44
5.2. State Route 4 Bottleneck Trends – 2015 Baseline Conditions 46
5.3. State Route 242 Bottleneck Trends – 2015 Baseline Conditions 53
5.4. Year 2015 Baseline Trends of Other freeways, Arterials, and Intersections 59
5.5. Intersection Analysis – 2015 Baseline 68
6. Ramp Metering Plan 71
6.1. Draft Metering Rates 75
6.2. Freeway Operations and Travel Time Comparison 78
6.3. Freeway System Performance Measures 83
7. Ramp Metering Effects on Other freeways, Arterials and Intersections 84
7.1. Other Freeways 84
7.2. Arterials 87
7.3. Intersections 100
7.4. Areawide Mobility Comparison 105
8. Implementation Plan 110
8.1. Next Steps 110

1. EXECUTIVE SUMMARY

The Metropolitan Transportation Commission (MTC) is working with the California Department of Transportation (Caltrans) to assist local agencies in evaluating new ramp metering projects for State Route 4 and State Route 242. KAI was tasked with completing the first phase of the study, which included working with MTC, Caltrans, Contra Costa Transportation Authority (CCTA), TRANSPAC, and TRANSPLAN to:

1. Study the feasibility and effects of ramp metering on SR 4 and SR 242,
2. Develop a staging plan for implementation of ramp metering on SR 4 and SR 242, and
3. Develop recommended ramp metering rates for the initial implementation segment.

This Ramp Metering Study and Implementation Plan is the result of those efforts. The next phase of this study, should the study participants choose to proceed, would be to develop a memoranda of understanding with local agencies, monitor traffic conditions following ramp meter activation, and conduct a "before and after" study of the effects for the initial implementation segment.

The Year 2015 was selected as the base analysis year for this study as ongoing construction east of Loveridge Road on SR 4 is projected to be completed that year. Draft metering rates were developed through an iterative process of evaluation using FREQ models developed and calibrated for both SR 4 and SR 242 corridors in order to optimally balance ramp delays and queues, as well as reduce mainline travel times. For the purpose of this evaluation, it was initially assumed that all on-ramps within the study limits would be activated by 2015 with the exception of freeway-to-freeway connectors (including the I-680/SR 4 and SR 4/SR 242 interchanges).

The 2015 metering plan is summarized as follows:

- Ramp meters would be activated only in the westbound direction on SR 4 and the southbound direction on SR 242 during weekday AM peak periods (6 AM to 10 AM).
- Ramp meters would be activated only in the eastbound direction on SR 4 and the northbound direction on SR 242 during weekday PM peak periods (3 PM to 7 PM).
- All meters (with the exceptions noted below) would be set to serve the peak hour demand at each ramp. Therefore, queues would not be expected to extend beyond a few vehicles and delays would not be expected to exceed the few seconds it would take to clear the cyclic surges of traffic arriving at the ramp meter from an upstream signal. The purpose of these meters is not to reduce the flow of traffic entering the freeway, but to smooth it, which would result in an approximate 2.5% increase in capacity at freeway bottleneck locations.
- During the AM peak period in the westbound direction of SR4, optimal metering rates are suggested for on-ramps upstream of Solano Way in Concord. The purpose of these meters would be to delay the onset of the expected bottleneck at Solano Way, providing mainline travelers with travel time savings.

- During the PM peak period in the eastbound direction, optimal metering rates are suggested for on-ramps west of a bottleneck at Port Chicago Highway, as well as on-ramps along SR 242 northbound that would also feed traffic into that bottleneck.

For on-ramp locations where optimal metering rates are suggested, the rates are set so that ramp queues would be contained within available storage at the ramps during the entire peak period. In so doing, the ramp queues would not interfere with traffic operations on adjacent arterial streets.

With implementation of this metering plan, freeway mainline operations would be affected as follows:

- SR 4 westbound travel time during AM peak period would be reduced by 10 minutes on average from SR 160 to Alhambra Avenue.
- SR 4 eastbound travel time during PM peak period would be reduced by over 9 minutes on average from Alhambra Avenue to SR 160.
- SR 4 westbound to SR 242 southbound (from SR 160 to I-680) travel time during AM peak period would be reduced by over 7 minutes on average.
- SR 242 northbound to SR 4 eastbound (from I-680 to SR 160) travel time during PM peak period would be reduced by over 1 minute on average.
- Freeway system (including both mainline and ramps on SR 4 and SR 242) vehicle hours of travel would be reduced by 10% during AM peak period and reduced by 11% during PM peak period.
- The productivity of the freeway system, measured in terms of vehicle miles of travel on the freeway, would be increased by 2% in both AM and PM peak periods.
- Average travel speeds through the freeway system would be improved by 13% in the AM peak period and improved by 14% in the PM peak period.

Potential traffic diversion effects were evaluated on key intersections and arterials. Based on the assessment, the amount of potential diversion would not result in a significant change in traffic operations on those facilities.

Ramp metering would result in benefits to the overall system performance measures for all roadway facilities in both Central and East Contra Costa County—as indicated by reductions in vehicle hours of delay, vehicle miles of travel, as well as increases in average system mean speeds—during both AM and PM peak hours.

Evaluations conducted for this study demonstrated that substantial travel time savings on freeway mainline would be achieved with the implementation of ramp metering along both corridors. Therefore, it is recommended that ramp meters be activated as soon as possible.

Below is a recommended staging plan that takes advantage of the schedule of current or planned projects to repair and install new equipment along SR 4 and SR 242:

- Stage 1 – to be completed by 2013 with MTC and Caltrans' *Ramp Metering and TOS Equipment Repair and Replacement* Project:
    - SR 4 eastbound and westbound on-ramps between Solano Way and Railroad Avenue
    - SR 242 northbound on-ramps
    - SR 242 southbound on-ramps

- Stage 2 – to be completed by 2015 with MTC and Caltrans' next *Freeway Performance Initiative Program (FPI), and SR 4 Widening Projects:*
    - SR 4 eastbound and westbound on-ramps west of Solano Way and east of Railroad Avenue

2. INTRODUCTION

The Metropolitan Transportation Commission (MTC) is working with the California Department of Transportation (Caltrans) to assist local agencies in evaluating new ramp metering projects for State Route 4 and State Route 242. KAI was tasked with completing the first phase of the study, which included working with MTC, Caltrans, Contra Costa Transportation Authority (CCTA), TRANSPAC, and TRANSPLAN to:

1. Study the feasibility and effects of ramp metering on SR 4 and SR 242,
2. Develop a staging plan for implementation of ramp metering on SR 4 and SR 242, and
3. Develop recommended ramp metering rates for the initial implementation segment.

This Ramp Metering Study and Implementation Plan is the result of those efforts. The next phase of this study, should the study participants choose to proceed, would be to develop a memoranda of understanding with local agencies, monitor traffic conditions following ramp meter activation, and conduct a "before and after" study of the effects for the initial implementation segment.

A series of deliverables have been completed for this ramp metering study, including an evaluation of draft metering rates and potential effects on local streets and intersections within Contra Costa County. Below is a summary of deliverables to date:

- Deliverable 3.2A - Analysis Methodologies Memo (Final was submitted on 3/27/2012)
- Deliverable 3.2F - Existing Conditions Memo (Final was submitted on 4/17/2012)
- Deliverable 3.2H - Existing Conditions and Future Trends Memo (Final was submitted on 6/4/2012)
- Deliverable 3.3A - Ramp Metering Rates (Draft was submitted on 8/6/2012, also incorporated in this report)
- Deliverable 3.3D - Final Ramp Metering Feasibility and Staging Plan (current report)

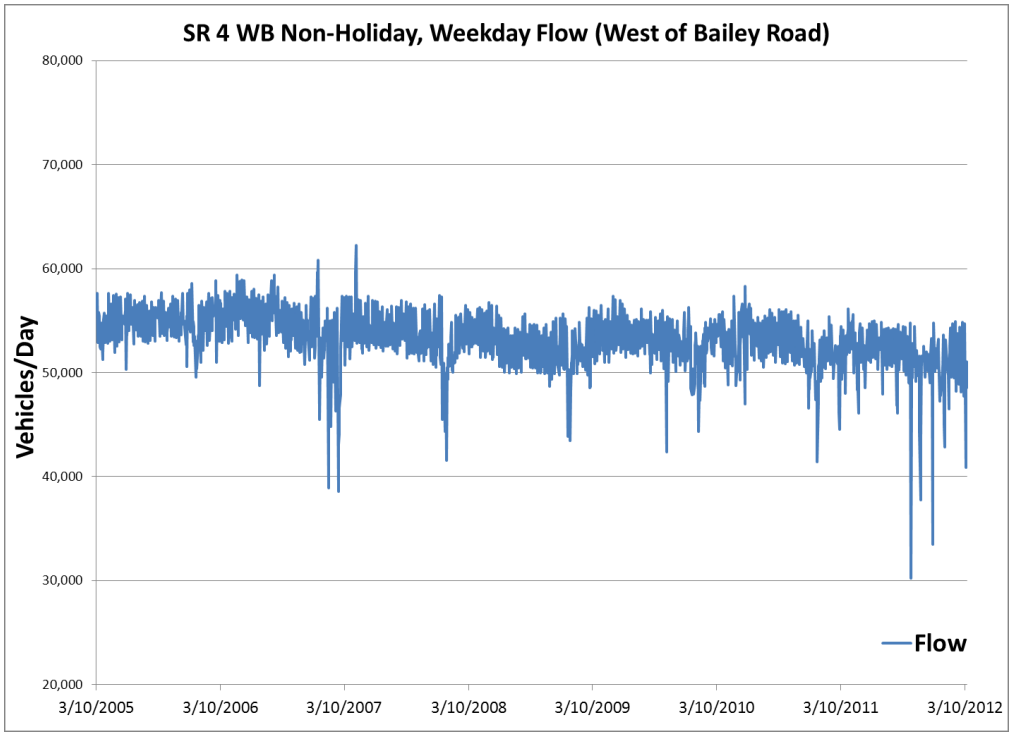
2.1. DEFINITION OF EXISTING CONDITIONS

Ordinarily, existing conditions are easily defined as those conditions present today and would typically be used to gauge the effects of a proposed project, or in this case, ramp metering. However, with the ongoing construction east of Loveridge Road on SR 4, it is necessary to establish a future baseline condition of Year 2015 that represents an as-close-as-possible condition just before ramp metering is implemented.

The construction projects on SR 4 make current traffic conditions in the corridor unrepresentative of those that would be present when construction is completed. In addition, the recent economic recession has caused traffic volumes to decrease from 2006/2007 levels (see Exhibit 1 and Exhibit 2). Therefore, Year 2011 or 2012 traffic counts could not be used to represent existing conditions.

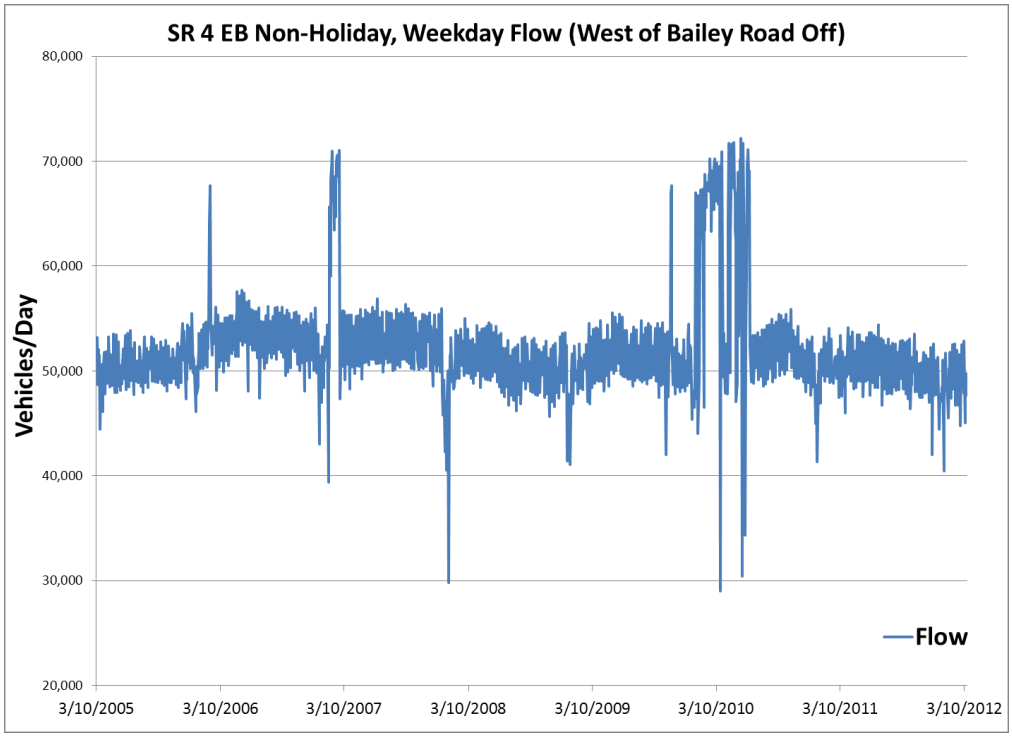
Instead, the consultant team used 2007/2009 counts and Contra Costa Countywide Travel Demand Model estimates to project 2015 traffic demands for conditions after SR 4 construction is completed.

Exhibit 1: Five Year Trend of SR 4 Volumes Westbound



Source: Caltrans PeMS (downloaded March 17, 2012)

Exhibit 2: Five Year Trend of SR 4 Volumes Eastbound



Source: Caltrans PeMS (downloaded March 17, 2012)

SR 4 is currently being widened between approximately 0.8 miles west of the Loveridge Road interchange to approximately 0.7 miles east of Hillcrest Avenue interchange. The widening is being implemented in two phases:

- **Loveridge Road to Somersville Road:** SR 4 will be widened to eight lanes—three mixed-flow and one HOV lane in each direction. This phase is scheduled to complete by December 2013.
- **Somersville Road to State Route 160:** SR 4 will be widened to eight lanes. Three of these lanes will be mixed-flow, an HOV lane in each direction from Somersville Road to Hillcrest Avenue (plus auxiliary lanes), and a wide median for transit. SR 4 will be widened to six lanes from Hillcrest Avenue to the interchange with State Route 160 and the new State Route 4 Bypass with three mixed-flow lanes in each direction. This phase is scheduled to complete by December 2014.

2.2. STUDY AREA

The study area consists of two defined areas. The smaller study area applies to the actual stretches of SR 4 and SR 242 being evaluated for ramp metering. The larger study area reflects the impact area of the ramp metering on the local streets and intersections. Exhibit 3 illustrates a map of the study corridors and vicinity area.

Ramp Meter Corridors Limits

- SR 4 between Alhambra Avenue and SR 160 Interchange (Post mile: CC 8.00 to 31.5 – approximately 23.5 miles), inclusive
- SR 242 I-680 to SR 4 interchanges (approximately 3.4 miles), inclusive

Impact Area Study Limits

Adjacent freeway segments, arterial segments, and intersections were analyzed to determine potential ramp metering effects on those facilities listed below:

Impact Area – Other Adjacent Freeways

- I-680 (SR 242 to Pacheco Blvd)
- SR 160 (SR 4 to Wilbur Ave)
- SR 4 east of SR 160 (previously known as SR 4 Bypass)

Impact Area - Arterials in East County

- Bailey Road
- Buchanan Road
- East 10th Street/ Harbor Street
- A Street/East 18th Street
- Hillcrest Avenue
- James Donlon Boulevard and Extension
- Kirker Pass Road/Railroad Avenue
- Leland Road and Extension/Delta Fair Boulevard
- Lone Tree Way
- Ninth Street/Tenth Street
- Pittsburg-Antioch Highway
- Somersville Road
- Willow Pass Road
- Loveridge Road
- California Avenue

Impact Area - Arterials in Central County

- Alhambra Avenue
- Contra Costa Boulevard
- Pacheco Boulevard
- Treat Boulevard
- Ygnacio Valley Road
- Kirker Pass Road

- Willow Pass Road/Evora Road
- Imhoff/Arnold Industrial Way
- Clayton Road

Impact Area - Intersections

On-Ramp Metered Intersections

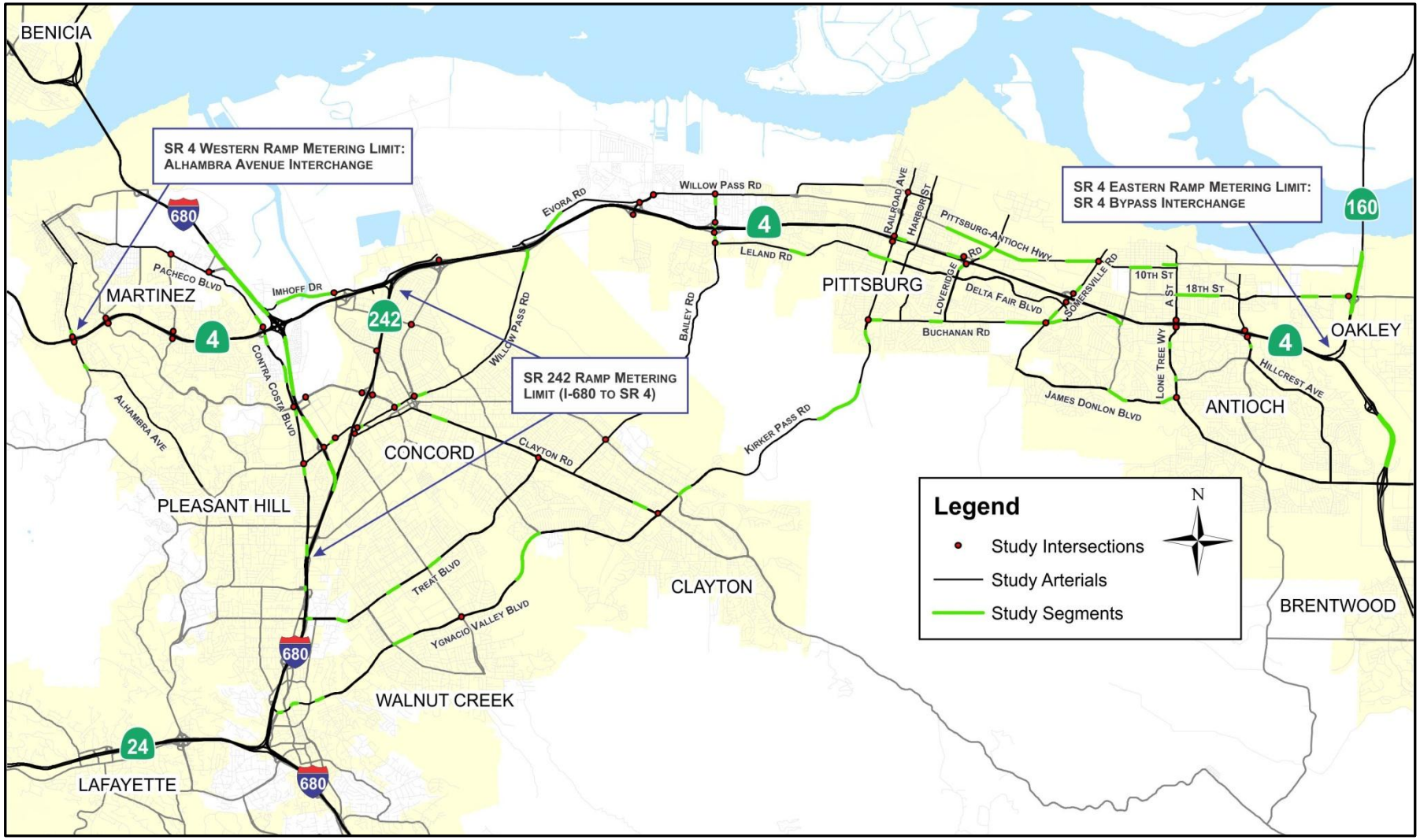
1. SR 4 WB On-Ramp and Alhambra Avenue (Martinez)
2. SR 4 EB On-Ramp and Alhambra Avenue (Martinez)
3. SR 4 WB On-Ramp and Pine Street (Martinez)
4. SR 4 EB On-Ramp and Center Avenue (Martinez)
5. SR 4 WB On-Ramp and Morello Avenue (Martinez)
6. SR 4 EB On-Ramp and Morello Avenue (Martinez)
7. SR 4 WB On-Ramp and Pacheco Boulevard (Martinez)
8. SR 4 WB ramp/Solano Way and Arnold Industrial Way/Imhoff Dr (Concord)
9. SR 4 WB On-Ramp and Port Chicago Highway (Concord)
10. SR 4 WB On-Ramp and Willow Pass Road (Bay Point)
11. SR 4 EB On-Ramp and San Marco Boulevard (Bay Point)
12. SR 4 WB On-Ramp and Bailey Road (Pittsburg)
13. SR 4 EB On-Ramp and Bailey Road (Pittsburg)
14. SR 4 WB On-Ramp and Railroad Avenue (Brentwood)
15. SR 4 EB On-Ramp and Railroad Avenue (Pittsburg)
16. SR 4 WB On-Ramp and California Avenue (Pittsburg)
17. SR 4 EB On-Ramp and Loveridge Road (Pittsburg)
18. SR 4 WB On-Ramp and Somersville Road (Antioch)
19. SR 4 EB On-Ramp and Somersville Road On-Ramp (Antioch)
20. SR 4 WB On-Ramp and A Street (Brentwood)
21. SR 4 EB On-Ramp and Lone Tree Way (Antioch)
22. SR 4 WB On-Ramp and Hillcrest Avenue (Antioch)
23. SR 4 EB On-Ramp and Hillcrest Avenue (Antioch)
24. SR 242 SB On-Ramp and Solano Way (Concord)
25. SR 242 SB On-Ramp/Commerce Avenue and Concord Avenue (Concord)
26. SR 242 NB On-Ramp/Market Street and Concord Avenue (Concord)
27. SR 242 SB On-Ramp and Clayton Road (Concord)

Other Intersections Away from SR 4 and SR 242

28. Pacheco Boulevard and Morello Avenue (Martinez)

29. Pacheco Boulevard and Arthur Road (Martinez)
30. Contra Costa Boulevard and Chilpancingo Parkway (Pleasant Hill)
31. Concord Avenue and Diamond Boulevard (Concord)
32. Contra Costa Boulevard and Sunvalley Boulevard/Willow Pass Road (Pleasant Hill)
33. I-680 NB On-Ramp and Willow Pass Road (Concord)
34. Diamond Boulevard and Willow Pass Road (Concord)
35. Willow Pass Road and Market Street (Concord)
36. Port Chicago Highway and Olivera Road (Concord)
37. Port Chicago Highway and Willow Pass Road (South) (Concord)
38. Willow Pass Road/Galindo Street (Concord)
39. Port Chicago Highway and Willow Pass Road (North) (Bay Point)
40. Willow Pass Road and Bailey Road (Bay Point)
41. Bailey Road and W Leland Road (Bay Point)
42. Tenth Street and Railroad Avenue (Pittsburg)
43. Railroad Avenue and Buchanan Road (Pittsburg)
44. Auto Center Drive (Somersville) and W 10th Street (Antioch)
45. Buchanan Road and Somersville Road (Antioch)
46. Lone Tree Way and Ridgerock Drive (John Donlon Boulevard) (Antioch)
47. E 18th Street (Main Street) and Route 160 On-Ramp (Antioch)
48. Bailey Road and Concord Boulevard (Concord)
49. Clayton Road/Treat Boulevard (Concord)
50. Ygnacio Valley Road/Kirker Pass Road and Clayton Road (Concord)
51. Ygnacio Valley Road and Oak Grove Road (Walnut Creek)
52. California Avenue and Loveridge Road (Pittsburg)
53. W Leland Road and Railroad Avenue (Pittsburg)

Exhibit 3: Study Area



3. STUDY APPROACH

This chapter provides a summary of recommended travel demand forecasting and traffic operations analysis methodologies that were applied to develop the ramp metering plans presented in this report.

3.1. TRAVEL DEMAND FORECASTING METHODOLOGY

The current official version of the Contra Costa Countywide Travel Demand Model (the 2000 CCTA Decennial Model) was used to develop travel forecasts for 2015 and 2030 conditions in this study.

KAI is currently working with CCTA to update the Decennial model. During this process, it was found that, at a majority of the locations, 2010 observed traffic volumes are either similar or lower than the 2000 traffic volumes collected previously. Therefore, it was determined that the 2000 base year model would be applied to reflect 2010 conditions.

In order to develop forecasts for 2015 (since there is no socioeconomic data set associated with this horizon year), the forecast results between the 2000 base year and future 2030 forecast volumes were interpolated, assuming the 2000 base year is the same as the 2010 base year. Thus, 2015 forecasts were estimated by taking the model 2000 volumes and increasing them by 5/20 of the model forecasted growth in traffic between 2000 and 2030.

3.2. RECOMMENDED ANALYSIS TIME PERIODS

Based on an examination of the SR 4 CSMP data, the following analysis time periods were recommended for evaluation of ramp metering on SR 4 and SR 242 in order to fully capture the onset and dissipation of congestion:

- **Typical weekday 4-hour AM peak period:** (6:00 AM to 10:00 AM) of SR 4 Westbound and SR 242 Southbound
- **Typical weekday 4-hour PM peak period:** (3:00 PM to 7:00 PM) of SR 4 Eastbound and SR 242 Northbound

Evaluations of other facilities—including other freeways, arterials, and intersections—were conducted for typical AM and PM peak hours.

3.3. EXISTING DATA SOURCES

Existing traffic data were gathered from various available sources as described below. New data collection was not conducted given the many studies recently completed for the corridor.

SR 4 Freeway

Existing conditions data were compiled from the SR 4 Corridor System Management Plan, the SR 4 Freeway Performance Initiative, and the on-going CCTA SR4 Integrated Corridor Analysis Study.

SR 242 Freeway

Existing data for SR-242 were obtained from Caltrans' Freeway Performance Measuring System (PeMS) database, Caltrans census counts, SR 242 Corridor Plan/Transportation Concept Report (Caltrans District 4, 2011), and available MTC and/or CCTA databases.

Other Freeways and Arterials

Counts for the other freeways and arterials were compiled from information already contained in the CCTA model.

Intersections

CCTA and local agencies were contacted to obtain intersection counts from their files for any intersections they wished to include in the analysis that were not already covered in prior SR 4 CSMP, FPI, or CMP work.

3.4. TRAFFIC OPERATIONS ANALYSIS METHODOLOGIES AND

For ramp meter corridors on SR 4 and SR 242, traffic operations analysis were conducted using a macroscopic simulation tool - FREQ as described below. Performance measures for these two freeway corridors were reported based on simulated constraints and throughput results. Evaluations for other facilities, including intersections, arterials, and system-wide effects, performance measures were computed based on traffic demands and available capacity, such as volume to capacity ratio (v/c).

SR 4 and SR 242 Ramp Meter Corridors

FREQ12 was the analysis tool used to evaluate freeway operations and develop optimized ramp metering rates for these two corridors. This is the tool Caltrans typically uses for ramp metering studies and was also the tool used for the SR 4 CSMP study.

Other Freeways and Arterials

The segment analyses of other freeways and surface streets were based on AM and PM peak hour volumes, v/c ratio, mean speed by segment, and congested travel times (as applicable).

Intersections

Intersection level of service (LOS) was evaluated and reported using CCTALOS methodology prescribed in CCTA's Technical Procedures Update (July 2006) and Traffix software. The analysis for

the intersection of Clayton Road and Treat Boulevard was performed using Synchro software to better assess diversion effects of queuing at this location.

System-Wide Performance

The CCTA model was used to compute appropriate system-wide performance statistics (VMT, VHT, mean speed, PMT, PHT) for 2015 and 2030, reflecting the countywide effects with ramp metering and without metering.

3.5. FUTURE PROJECTS IN YEAR 2015 AND YEAR 2030 IN THE STUDY AREA

Year 2015 Approved or Funded Projects

Based on information provided in the SR 4 CSMP document, several approved or funded projects were identified in the study area that would significantly affect 2015 traffic operations on SR 4. These projects were incorporated when developing future conditions. This information is consistent with the Contra Costa Countywide Comprehensive Transportation Plan (Adopted May 2004 and updated in 2009).

The SR 4 East Widening Project (Loveridge Road to SR 160) is a freeway widening project that would widen SR 4 from the existing four lanes to eight lanes. The widened freeway would generally consist of one HOV lane and three mixed-flow lanes in each direction. However, the HOV lanes would not extend for the entire length of the project; the westbound HOV lane would begin and the eastbound HOV lane would terminate in the vicinity of Hillcrest Avenue. Between the Hillcrest Avenue and State Route 160 interchanges, there would be three mixed-flow lanes in each direction. This project would reserve sufficient width in the SR 4 median to accommodate future public transportation investments (i.e. eBART) and would reconstruct and/or partially reconstruct interchanges at Loveridge Road, Somersville Road, Contra Loma Boulevard/L Street, Lone Tree Way/A Street, and Hillcrest Avenue.

SR 4 East of SR 160 (also known as the SR 4 Bypass) connects the communities of Oakley and Brentwood to SR 4 and includes segments described below. Although these improvements are included in the CCTA regional demand model for the purpose of forecasting future travel demands for the project, only the freeway portion of the SR 4 Bypass that is already completed or planned for completion by the Year 2015 (Segment 1 and the portion of Segment 2 from Lone Tree Way to Sand Creek Road) were assumed for Year 2015.

1. Segment 1 of this facility was completed in 2008; it is a four- to six-lane freeway located between the SR 4/SR 160 Interchange and Lone Tree Way. In addition to the two interchanges at the segment's termini, there is one interchange located at Laurel Road.
2. Segment 2 of the SR 4 Bypass, completed in 2002, is a two-lane expressway located between Lone Tree Way and Balfour Road. There are plans to upgrade the segment from

Lone Tree Way to Sand Creek Road to a four-lane freeway with an interchange at Sand Creek Road by 2012. This entire segment is planned to eventually be upgraded to a four-lane freeway facility all the way to Balfour Road, with an interchange at Balfour Road.

In addition, the intersection of SR 4 westbound ramps and Solano Way/Arnold Industrial Way/Imhoff Drive would be signalized by Year 2015. The intersection of Clayton Road and Treat Boulevard would operate with an eight-phase plan by Year 2015. It currently operates with a 6-phase plan.

Year 2030 Planned Future Projects

Year 2030 baseline scenario reflects projects assumed in the current adopted CCTA Decennial Model for 2030 conditions. In addition, a 2030 unconstrained scenario is analyzed, which included other planned and foreseeable projects within the study area described below:

Interstate 680/State Route 4 Interchange Improvement Project – Based on the current plan, this project would include five phases* described as follows:

Phase 1 would replace the northbound I-680 to westbound SR 4 loop ramp with a two-lane connector ramp that passes over both I-680 and SR 4. Auxiliary lanes would be added on northbound I-680 from the Concord Avenue on-ramp to the connector ramp and from the connector ramp to Morello Avenue. The existing loop ramp would be removed and the existing auxiliary lane on westbound SR 4 would be lengthened to the divergence point of the westbound SR 4 to northbound I-680 diagonal ramp and SR 4. The design of Phase 1 (and Phase 2, described below) allows for the addition of local access ramps between Pacheco Boulevard and I-680, called "slip ramps." The Phase 1 slip ramp would require the relocation of the Blum Road/Pacheco Boulevard intersection 95 meters (312 feet) to the north and the modification of the existing Caltrans Park and Ride lot.

Phase 2 proposes a new eastbound SR 4 to southbound I-680 ramp with auxiliary lanes from the Morello Avenue on-ramp to the connector and from the connector to the Concord Avenue off-ramp. Phase 2 would also extend the existing auxiliary lane from the Muir Road/Pacheco Boulevard intersection to the eastbound SR 4 on-ramp and the eastbound SR 4 to northbound I-680 loop ramp. The existing diagonal ramp would be removed in this phase. Including a slip ramp at this location would create a connection between I-680 and Pacheco Boulevard. The connector ramp would be two lanes wide, but if the slip ramp were included in the project, a total of three lanes would follow the point where the slip ramp merges with the connector ramp.

Phase 3 would add one eastbound lane and one westbound lane in the existing median of SR 4 in the vicinity of I-680. The limits of this phase are from just west of the SR 4/Pacheco Boulevard and SR 4/Muir Road on- and off-ramps to just east of the SR 242 interchange.

Phase 4 would consist of a southbound I-680 to eastbound SR 4 direct-connector flyover ramp. It also would eliminate the existing southbound I-680 to eastbound SR 4 loop ramp. An auxiliary lane would be constructed on eastbound SR 4 from the connector to the Solano Way off-ramp.

Phase 5 would provide a westbound SR 4 to northbound I-680 direct connector to replace the existing diagonal ramp connection. Two additional improvements would be made to the westbound SR 4 to southbound I-680 direction: 1) the loop ramp in the northwest quadrant of the interchange (serving the westbound SR 4 to southbound I-680 movement) would be widened from a single lane to two lanes, and 2) the existing one-lane diagonal ramp in the southeast quadrant would be replaced to provide a two-lane ramp.

* Study was conducted by Caltrans in cooperation with the Contra Costa County Transportation Authority.

SR 4 Integrated Corridor Analysis** (ICA) – This study consolidates action plans for SR 4 and includes three major components, the I-680/SR 4 interchange project as described above, the SR 4 CSMP improvements, and Scenario 5 improvements identified by the ICA study, which are described below:

- Extend HOV lane in the eastbound direction from east of the I-680 on-ramp to connect with existing western terminus at Port Chicago Highway interchange.
- Install a new fifth mixed-flow lane from SR 242 northbound connector to San Marco Boulevard off-ramp. Note also that as described above, reconfiguration of the I-680 interchange would extend the third mixed-flow lane to SR 242.
- Install a new fourth mixed-flow lane through the San Marcos Boulevard interchange – from off-ramp to on-ramp.
- Widen SR 4 eastbound off-ramp to San Marco Boulevard to two lanes.

** Study was conducted by the Contra Costa County Transportation Authority.

4. EXISTING CONDITIONS

This chapter describes existing conditions along the study corridors and surface streets in the project vicinity.

4.1. STATE ROUTE 4 EXISTING CONDITIONS

The SR 4 Corridor serves the local and regional travel needs to and through Contra Costa County. As such, the CCTA identifies SR 4 as a Route of Regional Significance (East County Action Plan for Routes of Regional Significance, August 2008).[1]

The SR 4 Corridor supports several travel markets including daily commuter trips, local freight and goods movements, recreational trips, regional trips, and intercity/local travel. It is a major east-west freeway serving various cities located along the corridor such as Hercules, Martinez, Concord, Pittsburg, Antioch, Oakley, Brentwood, and unincorporated Contra Costa County. SR 4 provides a major freeway connection between the northeast Bay in Contra Costa County, the I-80 Corridor, and the Central Valley and carries an average of 40,000 to 160,000 vehicles per day.[2] The truck traffic component is 4% to 7% of the total traffic volumes.[3]

SR 4 begins at the I-80 Interchange in Hercules to the west and is characterized as an expressway (partial access control) until Cummings Skyway, approximately 4.5 miles to the east.[4] SR 4 becomes a freeway (full access control) at Cummings Skyway and extends past the study area limit at SR 160 in Antioch to the east. There are generally two travel lanes in each direction between Hercules and Martinez, three travel lanes in each direction between Alhambra Avenue and the Glacier Drive overpass (west of the I-680 Interchange), two travel lanes in each direction between the Glacier Drive overpass and the SR 242 Interchange, three lanes plus one 2+ High-Occupancy Vehicle (HOV) lane in each direction between the SR 242 Interchange and Railroad Avenue (Pittsburg), and two lanes in each direction from Pittsburg to SR 160.

In the western segment of SR 4 between Hercules (I-80) and Martinez (I-680), there are eight interchanges located at Willow Avenue, Sycamore Avenue, Cummings Skyway, Franklin Canyon Road/McEwen Road, Alhambra Avenue, Pine Street/Center Avenue, Morello Avenue, and Pacheco Boulevard. In the central segment of SR 4 between the I-680 Interchange and Pittsburg, there are

1. Routes of Regional Significance are roadways that meet one or more of the following criteria: connect two or more "regions" of Contra Costa County; cross County boundaries; carry a significant amount of through-traffic; provide access to a regional highway or transit facility (e.g., a BART station or freeway interchange).

2. 2007 AADT. Traffic Data Branch. Caltrans. http://www.dot.ca.gov/hq/traffops/saferesr/trafdata/

3. 2007 Truck AADT. Traffic Data Branch. Caltrans. http://www.dot.ca.gov/hq/traffops/saferesr/trafdata/

4. There is no southbound I-80 to eastbound SR 4 connector at the interchange.

six interchanges located at Solano Way, SR 242, Port Chicago Highway, Willow Pass Road, San Marco Boulevard, and Bailey Road.

In the eastern segment of SR 4 between Pittsburg and SR 160, there are nine interchanges located at Railroad Avenue, Loveridge Road, Somersville Road, L Street/Contra Loma Boulevard, G Street, A Street/Lone Tree Way, Hillcrest Avenue, SR 4 Bypass, and E 18th Street/Main Street. Exhibit 4 depicts mainline lanes by post mile (PMABS) and interchange locations.

Major capacity improvements to the SR 4 Corridor system are either planned or under construction within the corridor, as discussed in previous sections of this report.[5] In addition, two other projects have been proposed:

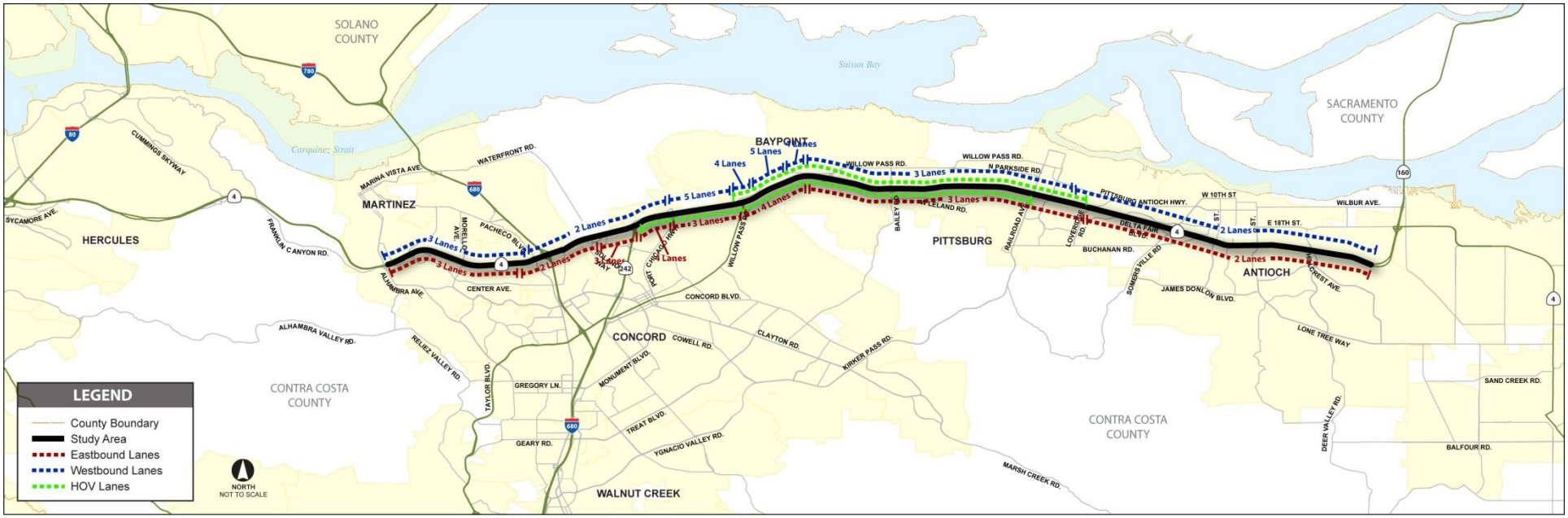
- **SR 4 Bypass Segment 3B** is a proposed extension of the recently constructed two-lane expressway from Balfour Road to Marsh Creek Road (Segment 3A) south of Marsh Creek Road to Vasco Road, which would be designated as a County road.
- **eBART** is a proposed BART system expansion into East Contra Costa County. The eBART Proposed Project would extend the BART system in the median of SR 4 approximately ten miles eastward from the existing Pittsburg/Bay Point BART station to a new station at Railroad Avenue in Pittsburg and a terminus station east of Hillcrest Avenue in Antioch. Self- propelled rail cars, also known as Diesel Multiple Unit (DMU), are the proposed vehicle technology for eBART.

The SR 4 Bypass connects the communities of Oakley and Brentwood to the SR 4 Corridor. Segment 1 of this facility, completed in 2008, is a four- to six-lane freeway located between the former SR 4/SR 160 Interchange and Lone Tree Way. Apart from the two interchanges at the segment's termini, there is one interchange located at Laurel Road. Segment 2 of the SR 4 Bypass, completed in 2002, is a two-lane expressway located between Lone Tree Way and Balfour Road. Along this segment, there is one signalized access point located at Sand Creek Road. The total length of these two segments is five miles. The SR 4 Bypass was not evaluated in this study.[5]

There is an extensive network of arterial roadways and local streets that provide access to SR 4, especially in the eastern segment of the Study Area connecting the cities of Pittsburg and Antioch. These streets can provide alternatives to SR 4 for local travel in the east-west direction parallel to SR 4. The main benefit of the network of arterials and local streets to the SR 4 Corridor is its potential to serve as alternative routings as part of the incident management plans for the SR 4 Corridor.

5. The SR 4 Bypass will be included in the evaluation of Future Conditions.

Exhibit 4 Characteristics of the SR 4 Corridor



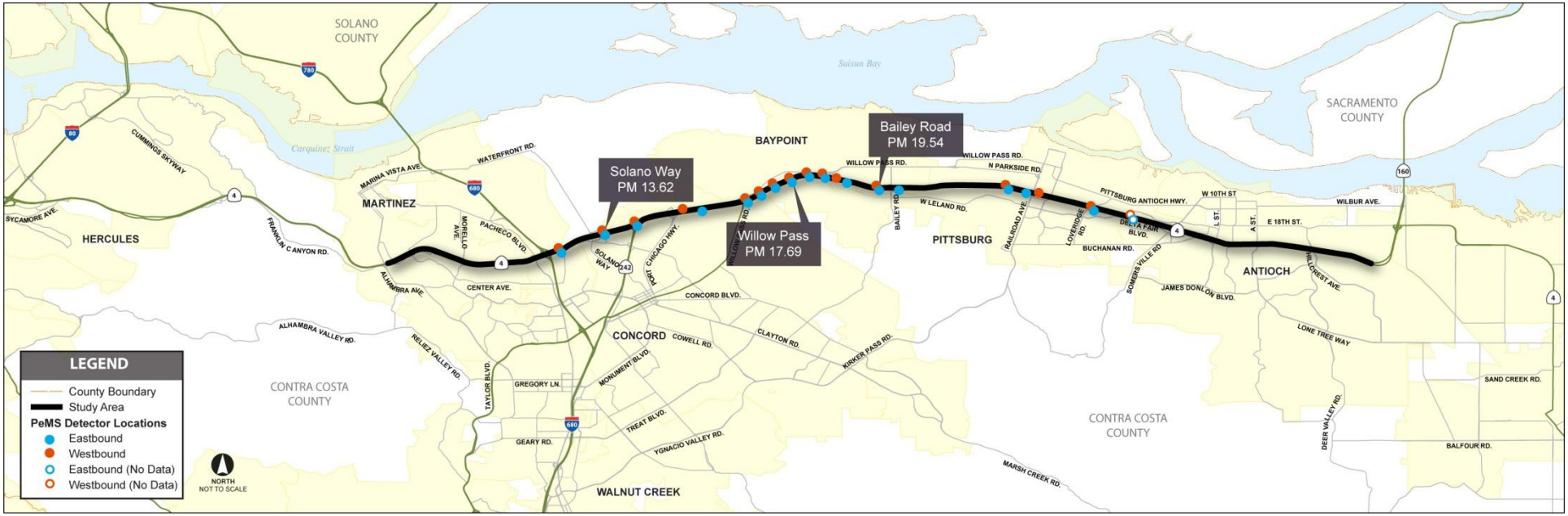
Traffic Characteristics of the SR 4 Corridor

The source of the data used to evaluate traffic characteristics was the Freeway Performance Measuring System (PeMS), which was developed jointly by Caltrans and the Partners for Advanced Transit and Highways (PATH) at the University of California, Berkeley. PeMS was used to extract detection data. The detection coverage area for the SR 4 Corridor is shown in Exhibit 5. While Caltrans strives for traffic detection to be located within one-third to a half-mile along the corridor, this has not yet been fully achieved. Key detection gaps exist between the I-80 and I-680 interchanges and between Pittsburg and SR 160. The three eastbound and three westbound detection locations that were used to evaluate traffic characteristics for the SR 4 Corridor are highlighted in the exhibit.

For each of the locations studied, hourly traffic volumes from PeMS were downloaded for the 52-week period from January 2, 2007 to December 27, 2007. There is a significant gap in detection coverage along the SR 4 Corridor in the western segment of the Study Area between I-80 and I-680, as well as the eastern segment of the Study Area between Bailey Road and SR 160.[6] As such, data in these subareas were substituted with available tachometer or "tach" runs (a.k.a. floating car runs, travel time runs). Tach runs were conducted using pilot cars that were introduced to the corridor in 15 to 30 minute headways. Data from multiple days (approximately 3 to 5 weekdays) with at least ten runs per direction per day were used to conduct the existing conditions analysis.

6. Although there are several detection locations in the eastern segment of the SR 4 Corridor between Bailey Road and SR 160, most of them have poor detector health (<80%) and were, therefore, not included in the analysis.

Exhibit 5: Detection Locations



Traffic characteristics were evaluated at three representative locations along the SR 4 Corridor to assess seasonal and daily variations in traffic volumes. Six data locations (three eastbound and three westbound) were chosen for this analysis. Data locations were chosen to 1) provide typical traffic characteristics from all segments of the SR 4 Corridor and 2) provide reliable, measured data based on 80% or higher detector health. The central segment of the SR 4 Corridor between I-680 and Bailey Road has the best detection coverage in the study area. The locations chosen were:

- Solano Way – Located in Concord, Contra Costa County between I-680 and SR 242
- Willow Pass Road – Located in Bay Point, Contra Costa between the two interchanges for Willow Pass Road
- Bailey Road – Located in Pittsburg, Contra Costa County, just west of the Bailey Road Interchange

HOV Lane Utilization

According to Caltrans' Year 2007 Annual HOV Lane Report, approximately 1,250 vehicles currently utilize the westbound HOV lane between Loveridge Road and Port Chicago Highway on SR 4 during the AM peak hour. Approximately 1,100 vehicles utilize the eastbound HOV lane between Port Chicago Highway and Railroad Avenue during the PM peak hour. These volumes are well below the 1,650 vehicle-per-hour maximum capacity (75% of the maximum capacity for a standard mixed- flow freeway lane) that the California Air Resources Board (CARB) and Caltrans have set as a standard for ideal HOV operating conditions. The average vehicle occupancy for the HOV lanes is 2.1 persons per vehicle for both peak hours and both directions.

Truck and Heavy Vehicle Traffic

The SR 4 Corridor serves local and intercity truck and heavy vehicle travel for surrounding communities such as Hercules, Martinez, Concord, Pittsburg, Antioch, Oakley, and Brentwood. Additionally, it provides access to I-80, the second longest interstate route in the US and a major route for interstate commerce.[7] Truck and heavy vehicle traffic makes up 4% to 7% of daily vehicle trips along the SR 4 Corridor.[8]

Ramp Metering Equipment

Ramp metering equipment currently exists at the at the following local access interchanges[9]:

- Solano Way (eastbound on-ramp only)
- Port Chicago Highway (eastbound on-ramp only)

7. The Dwight D. Eisenhower National System of Interstate and Defense Highways. Federal Highway Administration (FHWA). November 2002. http://www.fhwa.dot.gov/reports/routefinder/index.htm

8. 2007 Truck AADT. Traffic Data Branch. Caltrans. http://www.dot.ca.gov/hq/traffops/saferesr/trafdata/

9. None of the ramp meters in the SR 4 Corridor are currently activated/operational.

- Willow Pass Road (west)
- San Marco Boulevard (except for eastbound loop on-ramp)
- Bailey Road
- Railroad Avenue

Mobility in the SR 4 Corridor

The primary measures of mobility in a freeway corridor are travel time, speed, and delay. This study defines recurrent delay due to congestion as vehicle operating speeds of 35 mph or less over a period of 15 minutes or more. To identify bottlenecks and congested areas, detection data extracted from PeMS and tach runs for the September 2007 analysis period were plotted as speed contours by direction of travel for the average weekday.[10] Bottleneck locations were identified by evaluating the PeMS data, travel time data, traffic counts, and field observations of the SR 4 Corridor.[11]

AM Peak Period - Mainline and ramp Operations

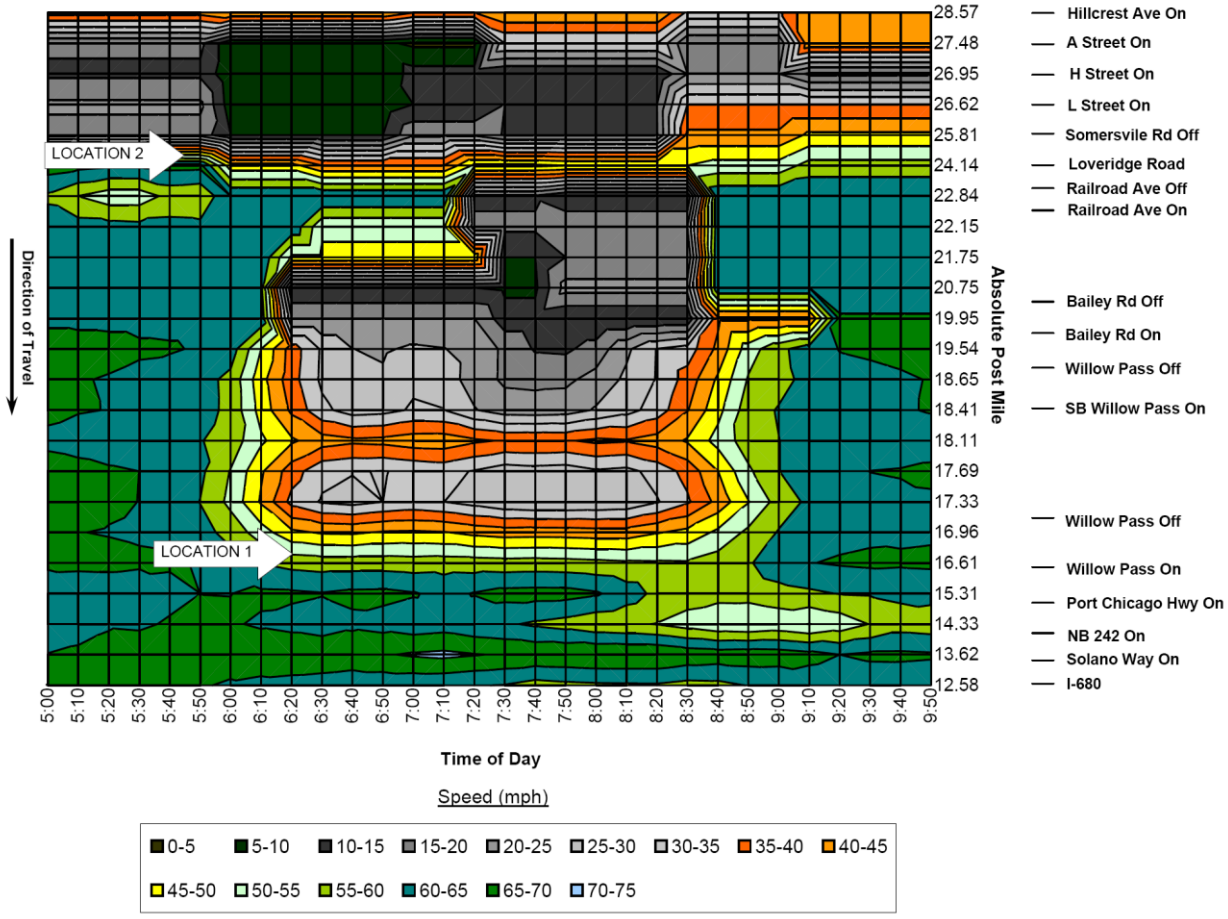
Exhibit 6 illustrates the speed contours for the morning peak period (5 AM to 10 AM) in the westbound direction of travel. The coverage shown in the exhibit is from Hillcrest Avenue in Antioch west to Pacheco Boulevard, which is located just west of the I-680 Interchange in Concord. This coverage coincides with the limits of data availability from PeMS and the available travel time runs for the corridor.

The areas outside of the coverage were reviewed in the field and assessed using available traffic count data and tach runs. No significant congestion was observed on SR 4 from I-80 to Pacheco Boulevard or east of Hillcrest Avenue in Antioch. This conclusion is also supported by the traffic count data and tach runs. Based on this finding, the bottlenecks identified in the SR 4 Corridor are limited to the area of coverage depicted in this exhibit.

10. PeMS data analysis period is September 1, 2007 to September 30, 2007. Tach run data analysis period is September 19, 2007 and September 20, 2007.

11. Field review of SR 4 was conducted on Thursday, November 6, 2008.

Exhibit 6: PeMS Speed Contours – SR 4 Westbound – AM Peak Period



As shown in Exhibit 6, the bottlenecks and congestion approaching these bottlenecks are generally consistent with the Caltrans 2008 State of the System report for SR 4 in Contra Costa County. Specifically, delays are indicated from the SR 242 and Port Chicago Highway Interchanges to Hillcrest Avenue.[12] [13] Two bottlenecks within these limits are controlling bottleneck locations in the morning peak period, westbound direction of travel. These are discussed in more detail in the Key Findings section of this report and are labeled in the exhibit as Location 1 and Location 2 as follows:

- Location 1 – Willow Pass Road (West) Westbound to Port Chicago Highway
- Location 2 – Somersville Road Westbound to Loveridge Road

12. "Congested Freeway Locations - Morning and Evening Commutes, 2007"; Caltrans, 2008. http://www.mtc.ca.gov/library/state_of_the_system/2008/am_pm_peak_period_congestion.pdf

13. Hillcrest Avenue is located just east of the A Street/Lone Tree Way location reported in the 2008 State of the System

Bottleneck Locations

- **Location 1 – Willow Pass Road (West) to Port Chicago Highway (Westbound AM):** The controlling bottleneck at this location is the four-lane section (three mixed-flow lanes plus one HOV lane) between these interchanges where the existing traffic demand exceeds the capacity of the cross section. Field observations also indicate that HOV lane users crossing two to three mixed- flow traffic lanes along this segment to exit at SR 242 or enter at Willow Pass Road contribute to the congested conditions. The speed data and field observations indicate that this bottleneck and the congestion approaching it extend over a 2.5-hour period that begins just after 6 AM and result in a queue that extends approximately 6 miles to the segment of SR 4 between Loveridge Road and Railroad Avenue in Pittsburg. The morning peak period delay associated with this bottleneck is 1,566 vehicle hours.
- **Location 2 – Somersville Road to Loveridge Road (Westbound AM):** The controlling bottleneck at this location on SR 4 is due to the high westbound traffic demand that exceeds the capacity of this two-lane mixed-flow section. In addition, the data show evidence of upstream embedded bottlenecks west of the A Street, G Street, and L Street on-ramps. The duration of the congestion approaching these bottlenecks is about 5 hours beginning before 5 AM and extending to 10 AM. Queues approaching these bottlenecks typically extend about 2.5 miles east to the vicinity of the Hillcrest Avenue Interchange. The total peak period delay associated with the controlling bottleneck and the upstream embedded bottlenecks is 2,470 vehicle hours.

Congested segments of SR 4 from Willow Pass Road to Loveridge Road in the westbound direction were reviewed to estimate the impact of the congestion on these segments on ramp queuing. The remaining section of westbound SR 4 had little to no queues or experienced micro queues that did not impact operations on SR 4 or the surface streets.

PM Peak Period – Mainline and Ramp Operations

Exhibit 7 illustrates the speed contours for the afternoon peak period (3 PM to 7 PM) in the eastbound direction of travel. As discussed above for the AM peak period, the coverage of the speed contour extends through the limits of the available PeMS and travel time data, while the remainder of the corridor was evaluated through field observations and reviews of available traffic count data. These reviews confirmed that the existing bottleneck locations and associated congestion are located within the limits shown in the exhibit.

Exhibit 7: PeMS Speed Contours – SR 4 Eastbound – PM Peak Period

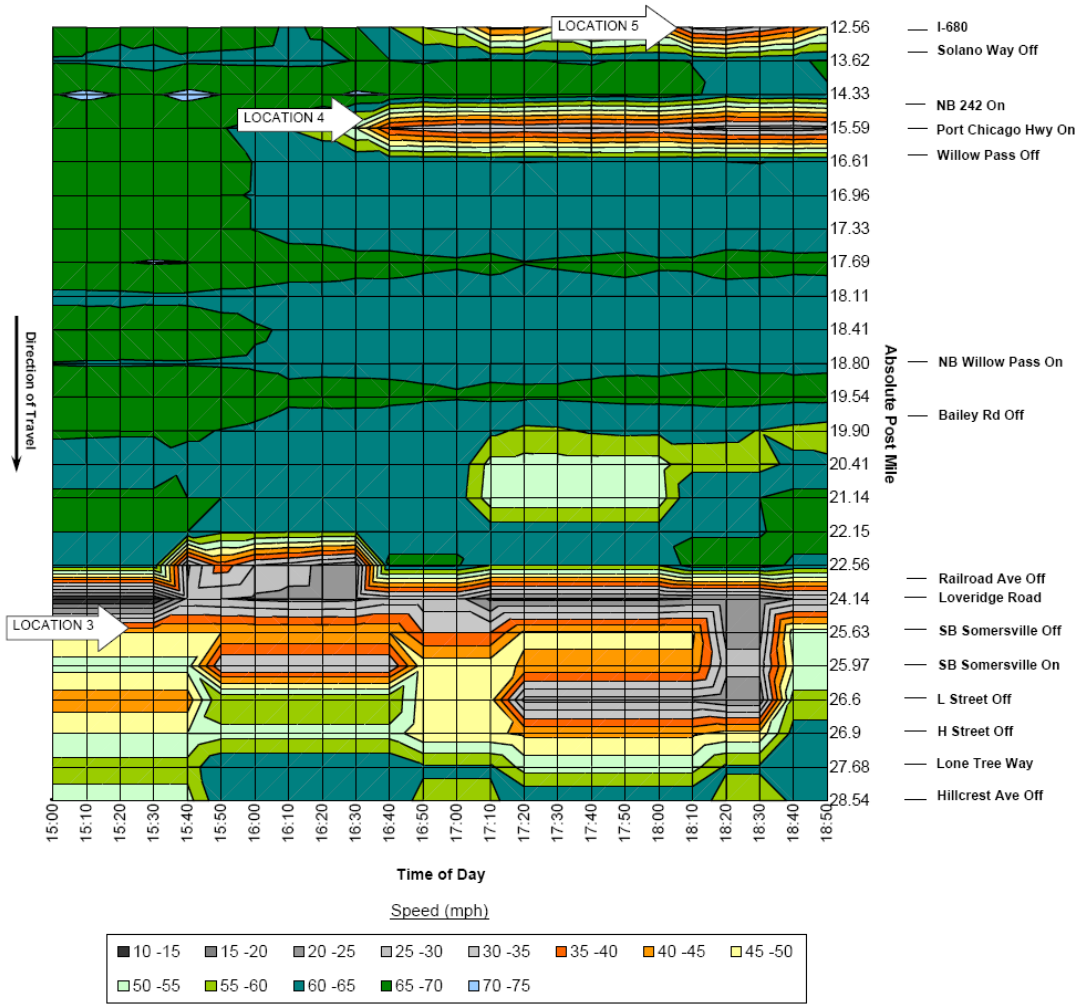


Exhibit 7 shows areas of congestion that are generally consistent with the 2008 State of the System report. Controlling bottleneck locations are indicated in this exhibit and are discussed in more detail in the Key Findings section of this report. The eastbound bottlenecks in the PM peak period are:

- Location 3 – Eastbound between Loveridge Road and Somersville Road
- Location 4 – Eastbound between SR 242 and Port Chicago Highway
- Location 5 – Eastbound between I-680 and Solano Way

Bottleneck Locations

- **Location 3 – Loveridge Road to Somersville Road Interchanges (Eastbound PM):** This bottleneck is caused by eastbound traffic demand that exceeds the capacity of this two-lane mixed-flow section of SR 4. There is also evidence of a downstream bottleneck that periodically develops between the Somersville Road on-ramp and the L Street off-ramp. The data and observations also indicate that, in some instances, the congestion approaching these bottlenecks can last for nearly 4 hours between about 3 PM and 6:50 PM, and queues

typically extend to the Railroad Avenue Interchange, 3 miles to the west. The afternoon peak period delay for approaching vehicles is 2,054 vehicle hours.

- **Location 4 – SR 242 and Port Chicago Highway (Eastbound PM):** This bottleneck occurs between the SR 242 and the Port Chicago Highway Interchanges where the number of lanes on SR 4 is reduced from five mixed-flow lanes that originate where the SR 242 three-lane ramp joins SR 4 to four mixed-flow lanes just before the eastbound HOV lane is introduced and again reduced to 3 mixed-flow lanes east of Port Chicago Highway undercrossing. While the congestion at this location is generally limited to the area of the bottleneck itself, queues approaching the bottleneck typically extend one-half mile west of the SR 4/SR 242 Interchange. Eastbound congestion approaching this bottleneck occurs in the afternoon between 4:50 PM and 6:50 PM and the resulting peak period delays are estimated at 318 vehicle hours.
- **Location 5 – I-680 to Solano Way (Eastbound PM):** This bottleneck develops between the I-680 northbound on-ramp and the Solano Way off-ramp where high on-ramp volumes from the I-680 northbound on-ramp merge with the SR 4 eastbound mainline. While the congestion at this location is generally limited to the area of the bottleneck itself, queues approaching the bottleneck typically extend 0.9 miles to the west. Eastbound congestion approaching this bottleneck occurs in the afternoon between 3:45 PM and 6:00 PM.[14]

The ramp from eastbound SR 4 to southbound I-680 is often congested due to back-ups on southbound I-680. While this does have an effect on SR 4 operations, the effect cannot be measured in this report because there is no PeMS or tach run data at this location.

Westbound on-ramp queues of approximately five vehicles were observed for the Somersville and Loveridge on-ramps. The San Marco Boulevard westbound on-ramp experiences a nine-vehicle queue and the on-ramp is approximately 1100 feet long; as such, the queues are contained within the ramp itself and do not influence operations on the mainline or the surface street. Similarly, the Willow Pass Road (east) westbound on-ramp experiences a queue of approximately eight vehicles, which is contained within the ramp. All other on-ramps function acceptably without any noticeable queuing during the AM peak hour

Ramp census data was reviewed for all on-ramps located within the vicinity of the congested mainline segments to assess impact of the congestion on ramp operations for existing conditions. On-ramps in the vicinity of the non-congested segments generally operate with no to minimal queues.

Short queues approaching the weaving section between the loop on-ramp from southbound I-680 were observed during the PM peak hour. These queues were confined to the area of the weaving section and do not extend on to the on-ramp itself. The eastbound on-ramp from SR 242

[14] The resulting peak period delays are unknown for this bottleneck location due to a lack of data.

consistently experiences congestion during the peak hour. This congestion is experienced approaching the on-ramp lane drop location at the merge point with eastbound SR4. Additional discussion regarding traffic operations for this ramp can be found in sections relating to SR 242. Short queues fewer than five vehicles were observed at the Somersville Road, Loveridge Road, and Railroad Avenue on-ramps.

Exhibit 8: Map of Recurrent Congestion Locations – AM Peak Hour

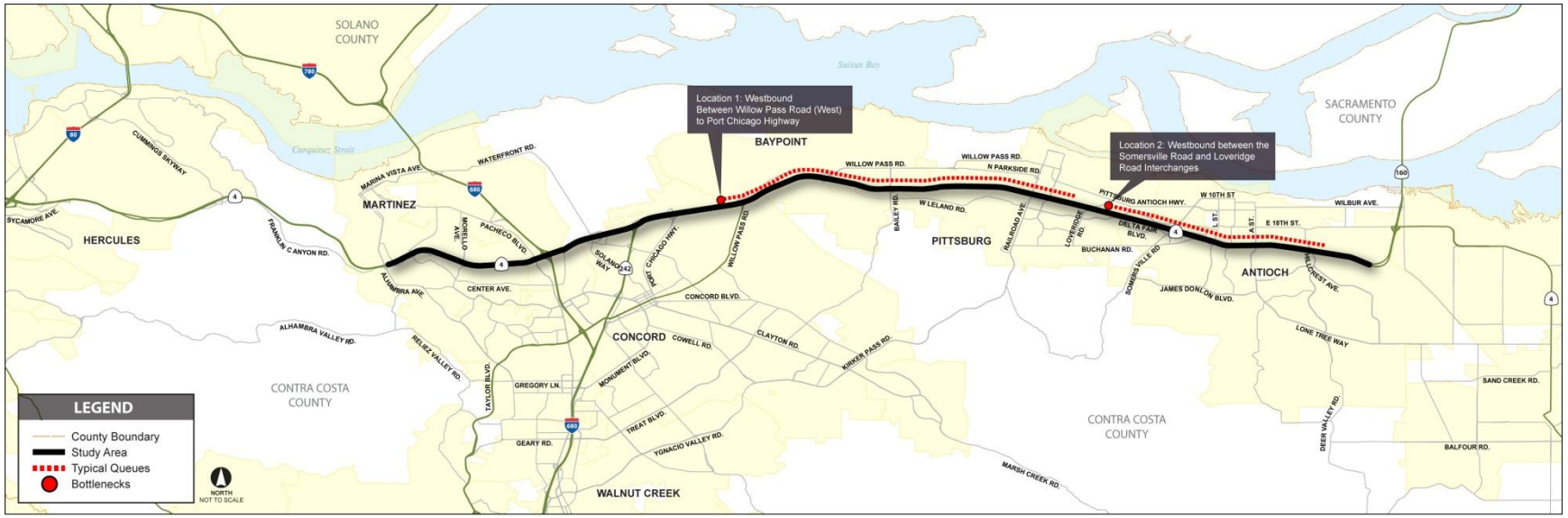
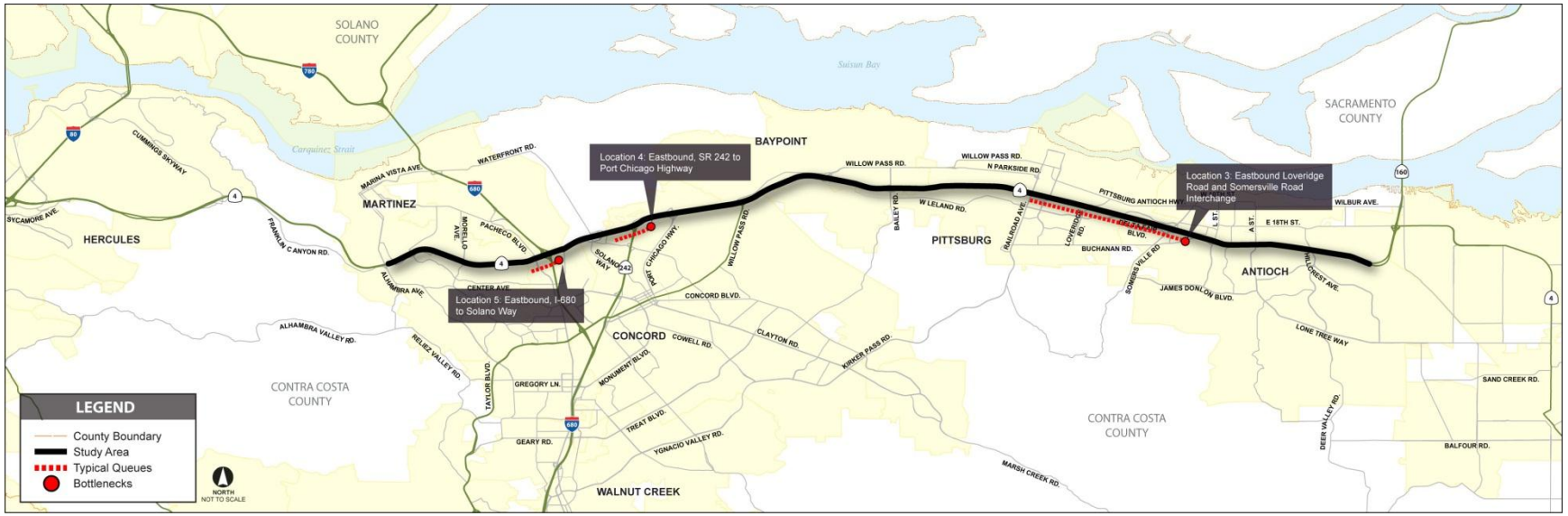


Exhibit 9: Map of Recurrent Congestion Locations – PM Peak Hour



Performance Measures

Exhibit 10 and Exhibit 11 summarize VMT, VHT, total delay, and congestion delay for the SR 4 Corridor for the morning peak period, afternoon peak period, and 24-hour daily period. Note that daily data are only presented where there were available PeMS data. Congestion delay was also only calculated where there were available PeMS data. For this analysis, total delay is measured by observed travel time on the corridor less the travel time under non-congested conditions (i.e., at assumed free flow speed of 60 mph). Congestion delay is a calculation of delay based on a threshold speed of 35 mph or less.

Exhibit 10: SR 4 Corridor Performance Measures – AM & PM Peak Periods

Performance Measure	Segment	Post Mile	Tuesday – Thursday	
			Eastbound 3:00 PM – 7:00 PM	Westbound 5:00 AM – 10:00 AM
Vehicle-Mile of Travel (VMT)	I-80 to I-680	PM 0.0 0 – PM 12.56	N/A [1]	N/A [1]
	I-680 to Bailey Rd	PM 12.56 – PM 19.90	133,058	156,728
	Bailey Rd to Hillcrest Ave	PM 19.90 – PM 28.54	83,300	184,892
	Hillcrest Ave to SR 160	PM 28.54 – PM 31.00	N/A [2]	N/A [2]
Vehicle-Hours of Travel (VHT)	I-80 to I-680	PM 0.00 – PM 12.56	N/A [1]	N/A [1]
	I-680 to Bailey Rd	PM 12.56 – PM 19.90	2,364	3,594
	Bailey Rd to Hillcrest Ave	PM 19.90 – PM 28.54	2,571	8,560
	Hillcrest Ave to SR 160	PM 28.54 – PM 31.00	N/A [2]	N/A [2]
Total Delay (VHD below 60 mph)	I-80 to I-680	PM 0.00 – PM 12.56	N/A [1]	N/A [1]
	I-680 to Bailey Rd	PM 12.56 – PM 19.90	418	1,264
	Bailey Rd. to Hillcrest Ave	PM 19.90 – PM 28.54	2,278	5,310
	Hillcrest Ave. to SR 160	PM 28.54 – PM 31.00	N/A [2]	N/A [2]
Congestion Delay (VHD for speeds less than 35 mph)	I-80 to I-680	PM 0.00 – PM 12.56	N/A [1]	N/A [1]
	I-680 to Bailey Rd	PM 12.56 – PM 19.90	228	687
	Bailey Rd to Hillcrest Ave	PM 19.90 – PM 28.54	N/A [3]	N/A [3]
	Hillcrest Ave to SR 160	PM 28.54 – PM 31.00	N/A [2]	N/A [2]

[1] Performance measure data not available between I-80 (PM 0.00) and I-680 (PM 12.56)

Exhibit 11: SR 4 Corridor Performance Measures - Daily

Performance Measure	Segment	Post Mile	Tuesday – Thursday	
			Eastbound	Westbound
Vehicle-Mile of Travel (VMT)	I-80 to I-680	PM 0.00 – PM 12.56	N/A [1]	N/A [1]
	I-680 to Bailey Rd	PM 12.56 – PM 19.90	443,439	426,460
	Bailey Rd to Hillcrest Ave	PM 19.90 – PM 28.54	277,614	503,096
	Hillcrest Ave to SR 160	PM 28.54 – PM 31.00	N/A [2]	N/A [2]
Vehicle-Hours of Travel (VHT)	I-80 to I-680	PM 0.00 – PM 12.56	N/A [1]	N/A [1]
	I-680 to Bailey Rd	PM 12.56 – PM 19.90	7,124	7,846
	Bailey Rd to Hillcrest Ave	PM 19.90 – PM 28.54	7,748	18,686
	Hillcrest Ave to SR 160	PM 28.54 – PM 31.00	N/A [2]	N/A [2]
Total Delay (VHD below 60 mph)	I-80 to I-680	PM 0.00 – PM 12.56	N/A [1]	N/A [1]
	I-680 to Bailey Rd	PM 12.56 – PM 19.90	547	1,461
	Bailey Rd to Hillcrest Ave	PM 19.90 – PM 28.54	2,985	6,140
	Hillcrest Ave to SR 160	PM 28.54 – PM 31.00	N/A [2]	N/A [2]
Congestion Delay (VHD for speeds less than 35 mph)	I-80 to I-680	PM 0.00 – PM 12.56	N/A [1]	N/A [1]
	I-680 to Bailey Rd	PM 12.56 – PM 19.90	248	745
	Bailey Rd to Hillcrest Ave	PM 19.90 – PM 28.54	N/A [3]	N/A [3]
	Hillcrest Ave to SR 160	PM 28.54 – PM 31.00	N/A [2]	N/A [2]

[1] Daily performance measure data not available between I-80 (PM 0.00) and I-680 (PM 12.56)
[2] Daily performance measure data not available between Hillcrest Ave (PM 28.54) and SR 160 (PM 31.00)
[3] Congestive delay data not available between Bailey Rd (PM 19.90) and Hillcrest Ave (PM 28.54)

Total SR 4 Corridor delay is 5,310 hours in the morning peak period (5:00 AM to 10:00 AM) and 2,278 hours in the afternoon peak period (3:00 PM to 7:00 PM). Congestion and recurring delay along the SR 4 Corridor are greatest in the eastbound direction during the afternoon peak period, which is consistent with the data presented in the 2008 State of the System.[12]

4.2. STATE ROUTE 242 EXISTING CONDITIONS

The SR 242 Corridor covers a total distance of approximately 4 miles between the I-680 interchange on the south end and the SR 4 interchange on the north end. SR 242 provides a freeway connection between the I-680 and the SR 4 in East Contra Costa County and carries an average of 80,000 to 117,000 vehicles per day. The truck traffic component is 5% of the total traffic volumes.[15] Existing freeway mainline volume and ramp volumes were extracted from Caltrans census database. All existing ramp volumes were collected in 2009; mainline volumes on SR 242 were collected in 2006, but were adjusted to reflect 2009 conditions based on other freeway mainline volumes observed on I-680 and SR 4 in the vicinity. This 4-mile segment generally has three mixed-flow travel lanes in each direction with auxiliary lanes through several interchanges. Existing free flow speed on SR 242 is 65 mph.

Currently, the study segment of SR 242 generally operates below freeway capacity during AM and PM peak periods on weekdays. Existing operational constraints were observed on the southern end in the southbound direction where SR 242 terminates and merges to I-680 southbound and on the northern end in the northbound direction where SR 242 terminates and merges to SR 4 eastbound. Those constraints were primarily due to mainline congestions on I-680 southbound and on SR 4 eastbound rather than capacity issue on SR 242.

Existing Ramp Metering Equipment

Ramp metering equipment was currently installed at all local access on-ramps along SR 242 in both directions except for the southbound on-ramp from Port Chicago Highway. Ramp meters are currently not operational.

Existing Bottlenecks and Queues

Based on existing field observations conducted in February 2012, the following operational constraints are identified:

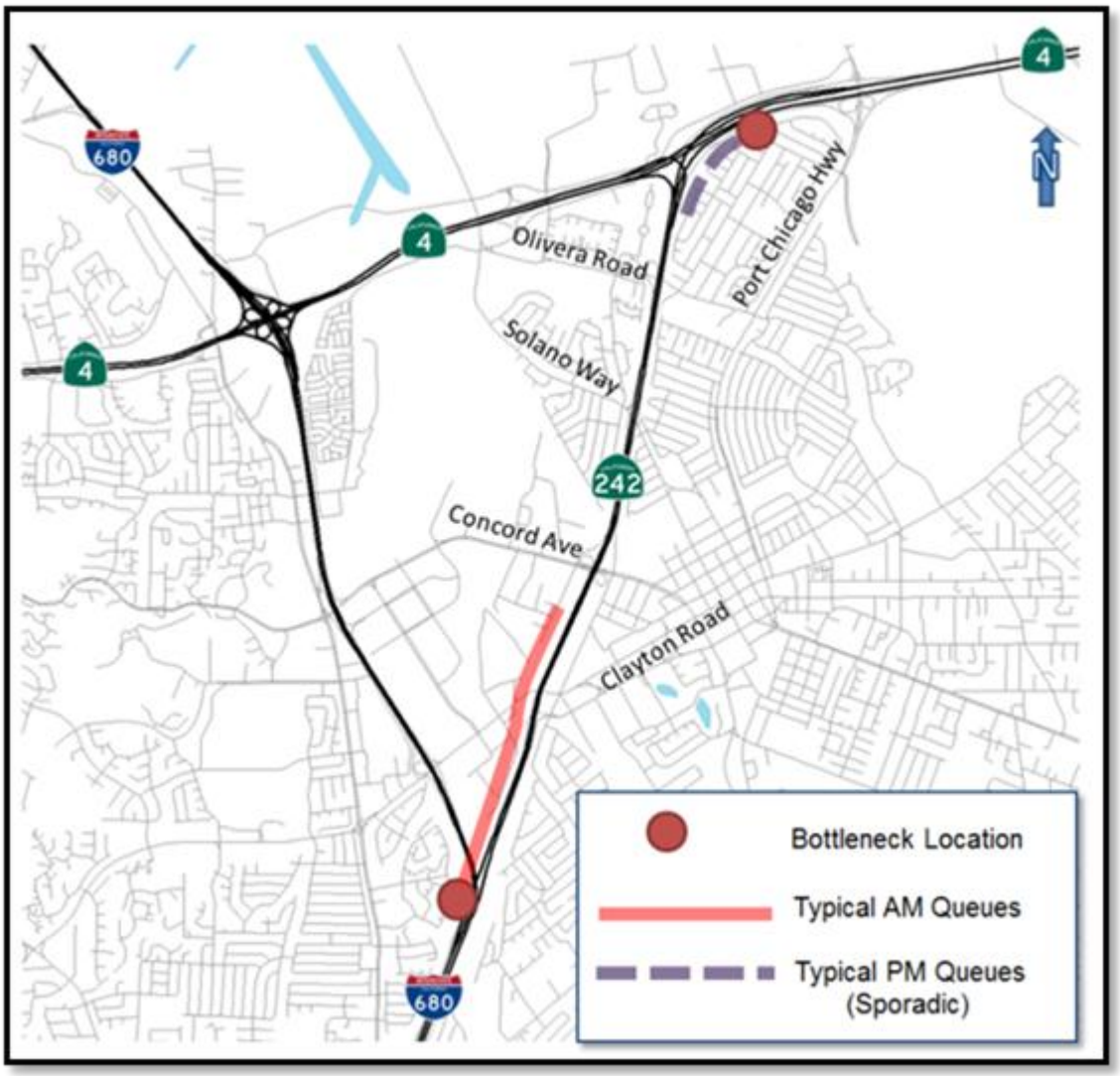
- **SR 242 Southbound:** During the AM peak period, a bottleneck on SB I-680 South of the SR 242 merge resulted in queues to extend onto SR 242. Queues typically extend between the Willow Pass Road and Concord Avenue underpasses. Congestion typically began at about 6:30 AM and dissipated approximately 8:30 AM. SR 242 southbound is the off-peak direction during the PM peak period, and no operational constraints were observed.
- **SR 242 Northbound:** During the PM peak period, a bottleneck that develops on SR 4 eastbound near Port Chicago that results in minor queues that extend onto SR 242. The queues were sporadic and were typically contained within the SR 242/SR 4 eastbound merge area. However, queues occasionally extended to north of the Port Chicago Highway off-ramp. SR 4 eastbound

[15] 2009 AADT and Truck Data. Traffic Data Branch. Caltrans. http://www.dot.ca.gov/hq/traffops/saferesr/trafdata/

at the SR 242 northbound merge was typically in queue, from further downstream bottlenecks at Port Chicago Highway and Willow Pass Road. Congestion on the SR 242 northbound to the SR 4 eastbound connector typically began at about 5:30 PM and dissipated approximately by 6:00 PM. Northbound is the off-peak travel direction during the AM peak period, and no operational constraints were observed.

These observations are consistent with the congestions described in the *SR 242 Corridor Plan/Transportation Concept Report*, which represented 2008 conditions. Freeway bottlenecks and congestion are graphically presented in Exhibit 12.

Exhibit 12: Graphics Illustration of Existing Bottleneck on SR 242



4.3. ANALYSIS OF OTHER FREEWAYS, ARTERIALS, AND INTERSECTIONS

This section describes the existing conditions of other key freeway corridors, arterials, and intersections within the study area, where ramp metering may potentially impact these facilities.

Other Freeways – Existing Conditions

As discussed in section 3.4, other freeway facilities were analyzed using v/c ratios. The existing conditions data for other freeway segments are included in Exhibit 13.

I-680

Mainline segments on the I-680 corridor were selected for evaluation between the SR 242 interchange on the south end and the Pacheco Blvd on the north end. Existing freeway mainline volume counts were used where available from the 2000 CCTA Model count database. In absence of count data, 2000 CCTA Model volumes were used. The study segment on I-680 generally has three mixed-flow travel lanes and an HOV lane in each direction with auxiliary lanes between interchanges.

Existing conditions on I-680 are summarized as follows:

- **I-680 Southbound:** During the AM peak hour, the v/c ratio varies from 0.77 to 0.88. Higher v/c ratios were observed towards the north end of the study corridor between Pacheco Boulevard and SR 4. During the PM peak hour, v/c ratios vary from 0.72 to 0.97. Greater v/c ratios were observed at the south end of the study corridor between Willow Pass Road and Willow Pass Road. Traffic volumes during the AM Peak period varied from 4,500 to 5,800 vph and from 4,300 to 5,600 vph during the PM peak hour.
- **I-680 Northbound:** During AM peak hour, the v/c ratio varies from 0.62 to 0.86. The observed v/c ratio was higher at the south end of the study section between SR 242 and south of Willow Pass Road. During the PM peak hour, the v/c ratio varies from 0.69 to 0.82 with the observed v/c ratio higher towards the north of the study corridor between Concord Avenue and SR 4. Traffic volume during AM Peak period varies from 4,300 to 4,900 vph and PM peak hour varies from 4,200 to 5,300 vph.

SR 160

SR 160 between SR 4 and Wilbur Avenue was selected for evaluation. Existing freeway mainline volumes were obtained from the 2000 CCTA model. The study segment on SR 160 has two mixed-flow travel lanes in each direction with auxiliary lanes through interchanges.

Existing conditions on SR 160 are summarized as follows:

- **SR 160 Southbound:** During both AM and PM peak hour, the v/c ratios vary from 0.10 to 0.12. Traffic volume during AM Peak period is 300 vph and PM peak hour varies from 400 to 500 vph.

- **SR 160 Northbound:** During both AM and PM peak hour, the v/c ratio varies from 0.10 to 0.12. Traffic volume during AM Peak period is 400 vph and PM peak hour varies 400 to 500 vph.

SR 4 East of SR 160

The freeway segment between Laurel Road and Lone Tree Way was selected as a study segment on State Route 4 east of SR 160. This segment has two mixed-flow travel lanes in each direction. Existing Year 2010 traffic volumes were extracted from the new CCTA count database. Current conditions of this segment are summarized as follows:

- **Southbound:** During AM and PM peak hour, the v/c ratios are 0.25 and 0.23, respectively. Traffic volume during AM Peak hour is 1000 vph and PM peak hour is 900 vph.
- **Northbound:** During AM peak hour the v/c ratio is 0.77 and PM peak hour the v/c ratio is 0.81. Traffic volume during AM Peak hour is 3100 vph and PM peak hour is 3300 vph.

Exhibit 13: Other Adjacent Freeway Segments - Existing Conditions Data Analysis

Freeway	From	To	Lanes		AM Peak Volume (vph)		PM Peak Volume (vph)		Capacity (vph)		AM v/c		PM v/c		Traffic Volume Data Source
			NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	
I-680	Pacheco Blvd	Arthur Road	3	3	4296	4717	4227	4339	5850	5850	0.73	0.81	0.72	0.74	2000 CCTA Model
	North of Willow Pass Road	South of Concord Ave	4	4	4695	5847	5267	5482	7600	7600	0.62	0.77	0.69	0.72	2000 CCTA Model
	Pacheco Blvd	SR 4	3	3	4745	5041	4595	4808	5700	5700	0.83	0.88	0.81	0.84	2000 CCTA Model
	North of Concord Ave	SR 4	3	3	4941	4962	4809	5337	5850	5850	0.84	0.85	0.82	0.91	2000 Count
	SR-242	South of Willow Pass Road	3	3	4909	4489	4578	5550	5700	5700	0.86	0.79	0.80	0.97	2000 CCTA Model
SR 160	Foot of Bridgehead Road	South of Wilbur Ave	2	2	358	265	396	427	3900	3900	0.09	0.07	0.10	0.11	2000 CCTA Model
	North of 18th Street	North of Oakley Road	2	2	394	314	477	461	3900	3900	0.10	0.08	0.12	0.12	2000 CCTA Model
SR 4 E/O SR 160	Lone Tree Way	Laurel Road	2	2	3090	995	3259	904	4000	4000	0.77	0.25	0.81	0.23	2010 Count

Arterials Existing Conditions

Arterial road segments in the proximity of SR 4 and SR 242 ramp metering corridors were considered for analysis, as they may potentially be affected by traffic diversion resulting from ramp metering. Several segments were identified for each of the arterial roadways based on the following procedures:

- **Arterials parallel to SR 4 or SR 242**: Segments were selected where they may experience potential diversions due to ramp metering. For longer arterial routes, segments between freeway interchanges were selected.
- **Arterials crossing SR 4 or SR 242**: Segments were selected to represent potential traffic diversions on either side of the freeway interchange.

Refer to Exhibit 14 for locations of study arterials segments. Existing conditions data for arterials are included in Exhibit 15. Existing arterial volume counts were used where available from the 2000 CCTA model count database. In absence of count data, 2000 CCTA model volumes were used.

Since the analysis is based on demand volumes and available capacity, calculated v/c ratio could exceed 1.0. Following is a list of studied segments with v/c ratio more than 1.0, which are also highlighted in Exhibit 15:

- Bailey Road NB (North of SR 4 and Canal Road): v/c is 1.14 during PM peak
- Buchanan Road
  - Between Railroad Avenue and west of Book Side Drive in westbound direction during AM peak v/c ratio is 1.39 and eastbound direction PM peak v/c ratio is 1.25
  - Between east of Meadows Avenue and Somersville Road in westbound direction during AM peak v/c ratio is 1.34 and eastbound direction PM peak v/c ratio is 1.39
  - Between Loveridge Road and McFaul Drive in westbound direction during AM peak v/c ratio is 1.02
  - Between (east of Railroad Avenue and Brookside Drive) in westbound direction during AM peak v/c ratio is 1.07
- Contra Costa Blvd (2nd Avenue and Center Avenue) in southbound during AM peak v/c ratio is 1.02 and in northbound direction during PM v/c ratio is 1.01
- Leland Road (Willow Avenue and Bailey Road) in eastbound direction during PM peak v/c ratio is 1.05
- Pacheco Boulevard (Blum Road and south of Arnold Drive) in northbound direction during PM peak v/c ratio is 1.06.
- Pittsburg-Antioch Highway
  - Between Verne Roberts Circle and Auto Center Drive in eastbound direction during AM peak v/c ratio is 1.18 and WB direction PM peak v/c ratio is 1.29
  - Between Loveridge Road and California Avenue in westbound direction during AM peak v/c ratio is 1.45 and eastbound direction PM peak v/c ratio is 1.27

- Treat Boulevard (Sheppard Road and Cherry Lane) in westbound during AM peak v/c ratio is 1.13 and in eastbound direction during PM v/c ratio is 1.32
- Willow Pass Road (SR 4 and Avila Road) in southbound during AM peak v/c ratio is 1.08 and in northbound direction during PM v/c ratio is 1.34
- Ygnacio Valley Road
  - Between Cowell Road and north of Oak Grove Road in southbound direction during AM peak v/c ratio is 1.53 and northbound direction PM peak v/c ratio is 1.54
  - Between east of Civic Drive and Walnut Boulevard in northbound direction during PM peak v/c ratio is 1.20
- Clayton Road
  - Between 5th Street and Davis Avenue in westbound direction during AM peak v/c ratio is 1.10 and EB direction PM peak v/c ratio is 1.08

Exhibit 14: Locations of Selected Arterial Segments

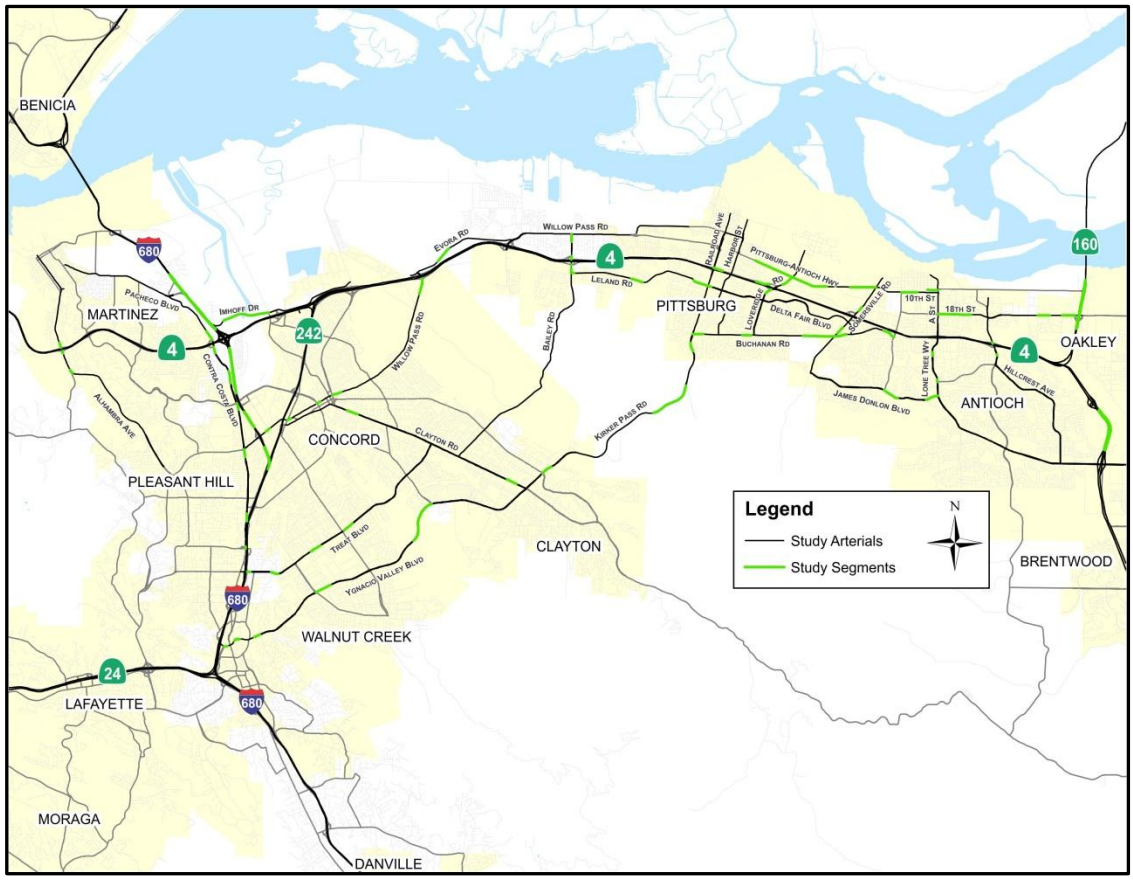


Exhibit 15: Arterial Existing Conditions Data Analysis

	Street Name	Direction	Cross Street 1	Cross Street 2	Lanes		AM Peak Volume (vph)		PM Peak Volume (vph)		Capacity (vph)		AM v/c		PM v/c		Traffic Volume Data Source
					NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	
1	10th St	East and West	H St	G St	1	1	74	903	867	218	950	950	0.08	0.95	0.91	0.23	2000 CCTA Model
			L St	K St	1	1	101	941	912	266	950	950	0.11	0.99	0.96	0.28	2000 CCTA Model
			K St	H St	1	1	70	882	843	211	900	900	0.08	0.98	0.94	0.23	2000 CCTA Model
2	18th St	East and West	A St	Alpha Way	1	1	131	846	795	223	950	950	0.14	0.89	0.84	0.23	2000 CCTA Model
			Alphaway	Crestwood Dr	1	1	151	842	799	264	950	950	0.16	0.89	0.84	0.28	2000 CCTA Model
			Crestwood Dr	Cavallo Road	1	1	190	937	914	344	950	950	0.20	0.99	0.96	0.36	2000 CCTA Model
3	9th St	East and West	C St	D St	1	1	26	158	166	58	700	700	0.04	0.23	0.24	0.08	2000 CCTA Model
			A St	C St	1	1	38	203	229	87	700	700	0.05	0.29	0.33	0.12	2000 CCTA Model
4	Alhambra Ave	North and South	Alhambra Valley Road	Kim Ct	1	1	445	416	499	625	950	950	0.47	0.44	0.53	0.66	2000 CCTA Model
			North of SR 4	North of Walnut Ave	2	2	1603	1147	1238	1574	1800	1800	0.89	0.64	0.69	0.87	2000 Count
			Franklin Canyon Road	South of SR 4	1	1	448	390	537	492	950	950	0.47	0.41	0.57	0.52	2000 Count
5	Bailey Rd	North and South	Leland Rd	Maylard St	2	3	1465	470	715	1682	1800	2700	0.81	0.17	0.40	0.62	2000 Count
			Willow Pass Road	Placer Dr	2	2	439	620	738	529	1900	1900	0.23	0.33	0.39	0.28	2000 Count
			North of Maylard St	S. of SR 4 (S. of On-ramp)	2	3	1375	1271	1416	1361	1800	2700	0.76	0.47	0.79	0.50	2000 CCTA Model
			North of SR 4	Canal Road	2	2	1762	822	2161	983	1900	1900	0.93	0.43	**1.14**	0.52	2000 Count
6	Buchanan Rd	East and West	Railroad Ave	West of Book Side Dr	1	1	354	1319	1191	639	950	950	0.37	**1.39**	**1.25**	0.67	2000 Count
			Somersville Road	West of Gentrytown Dr	2	2	258	867	960	362	1900	1900	0.14	0.46	0.51	0.19	2000 Count
			Del Oro Cir	Contra Loma Blvd	2	2	73	1399	1306	431	1900	1900	0.04	0.74	0.69	0.23	2000 CCTA Model
			East of Meadows Ave	Somersville Road	1	1	404	1270	1324	550	950	950	0.43	**1.34**	**1.39**	0.58	2000 Count
			Loveridge Road	Mcfaul Dr	1	1	368	973	920	803	950	950	0.39	**1.02**	0.97	0.84	2000 CCTA Model
			East of Railroad Ave	Brookside Dr	1	1	219	1018	875	597	950	950	0.23	**1.07**	0.92	0.63	2000 CCTA Model
7	Contra Costa Blvd	North and South	Chilpancingo Pkwy	North of Golf Club Rd	2	2	516	847	1736	1270	1900	1900	0.27	0.45	0.91	0.67	2000 Count
			North of Hookston Rd	Boyd Rd	2	2	586	1573	1756	1113	1900	1900	0.31	0.83	0.92	0.59	2000 Count
			Harriet Dr	Taylor Blvd	2	2	699	946	1746	1482	1960	1960	0.36	0.48	0.89	0.76	2000 Count
			2nd Ave	Center Ave	2	2	640	1996	1989	1272	1960	1960	0.33	**1.02**	**1.01**	0.65	2000 Count
			Oak Park Blvd	North of Oakpark Blvd	2	2	219	1227	586	517	1900	1900	0.12	0.65	0.31	0.27	2000 Count
8	E 18th St	East and West	West of SR 160	Phillips Ln	1	1	153	336	360	308	950	950	0.16	0.35	0.38	0.32	2000 Count
			Cavallo Road	Biglow Dr.	1	1	177	925	893	326	950	950	0.19	0.97	0.94	0.34	2000 CCTA Model
			Vineyard Dr	Willow Ave	1	1	127	597	564	198	950	950	0.13	0.63	0.59	0.21	2000 CCTA Model
9	Hillcrest Ave	North and South	Interchange (North of SR 4)	SR 4	3	3	1856	462	1520	637	2700	2700	0.69	0.17	0.56	0.24	2000 Count
			South of Larkspur Dr	North of Davison Dr	3	3	2191	973	1401	2118	2700	2700	0.81	0.36	0.52	0.78	2000 CCTA Model
10	James Donlon Blvd	East and West	Contra Loma Blvd	Blythe Dr	2	2	139	736	928	232	1900	1900	0.07	0.39	0.49	0.12	2000 CCTA Model
			S Royal Links Cir	Lone Tree Way	2	2	482	987	1194	713	1900	1900	0.25	0.52	0.63	0.38	2000 Count
11	Kirker Pass Rd	North and South	Concord Blvd	Kirkwood Dr	3	3	532	2252	2322	686	2850	2850	0.19	0.79	0.81	0.24	2000 Count
			Nortonville Rd	North of Hess Rd	2	2	416	1802	1215	639	1900	1900	0.22	0.95	0.64	0.34	2000 CCTA Model
			Castlewood Dr	Pheasant Dr	2	2	518	1793	1268	772	1800	1800	0.29	1.00	0.70	0.43	2000 CCTA Model

	Street Name	Direction	Cross Street 1	Cross Street 2	Lanes		AM Peak Volume (vph)		PM Peak Volume (vph)		Capacity (vph)		AM v/c		PM v/c		Traffic Volume Data Source
					NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	
12	Leland Rd	East and West	Railroad Ave	West of Presidio Ln	2	2	445	1046	1421	617	1900	1900	0.23	0.55	0.75	0.32	2000 Count
			Crestview Dr	Railroad Ave	2	2	484	843	1124	636	1900	1900	0.25	0.44	0.59	0.33	2000 Count
			John Johnson Pkwy	West of Golf Club Rd	2	2	153	1195	590	246	1900	1900	0.08	0.63	0.31	0.13	2000 CCTA Model
			Willow Ave	Bailey Rd	2	2	197	1571	1998	495	1900	1900	0.10	0.83	**1.05**	0.26	2000 Count
13	Lone Tree Wy	North & South	Worrell Rd	Hillside Rd	2	2	1449	338	563	1531	1900	1900	0.76	0.18	0.30	0.81	2000 CCTA Model
			South of Clearbrook Rd	Davison Dr	2	2	1365	291	491	1422	1800	1800	0.76	0.16	0.27	0.79	2000 CCTA Model
14	Pacheco Blvd	North and South	Blum Road	South of Arnold Dr	1	1	636	900	953	782	900	900	0.71	1.00	**1.06**	0.87	2000 Count
			Muir Rd	Buchanan Cir	2	2	408	465	709	521	1900	1900	0.21	0.24	0.37	0.27	2000 Count
			1st Ave	Center Ave	2	2	556	1444	1367	1074	1900	1900	0.29	0.76	0.72	0.57	2000 Count
15	Pittsburg-Antioch Hwy	East and West	Verne Roberts Cir	Auto Center Dr	1	1	1124	251	474	1229	950	950	**1.18**	0.26	0.50	**1.29**	2000 Count
			Loveridge Road	Columbia St	1	1	254	851	783	267	950	950	0.27	0.90	0.82	0.28	2000 Count
			Loveridge Road	California Ave	1	1	197	1378	1205	512	950	950	0.21	**1.45**	**1.27**	0.54	2000 Count
16	Somersville Rd	North & South	Century Blvd	Sycamore Dr	3	3	645	798	1632	1460	2700	2700	0.24	0.30	0.60	0.54	2000 Count
			Delta Fair Blvd	Fairview Dr	2	2	361	102	164	397	1800	1800	0.20	0.06	0.09	0.22	2000 CCTA Model
17	Treat Blvd	East and West	I-680	Oak Rd	3	3	1282	2187	2061	1837	2850	2850	0.45	0.77	0.72	0.64	2000 Count
			East of Oak Grove Rd	Blarney Ave	3	3	249	2300	1674	603	2850	2850	0.09	0.81	0.59	0.21	2000 CCTA Model
			Sheppard Rd	Cherry Ln	3	3	1897	3323	3876	2346	2940	2940	0.65	**1.13**	**1.32**	0.80	2000 Count
			Arkell Rd	Winton Dr	3	3	475	2330	1663	950	2850	2850	0.17	0.82	0.58	0.33	2000 CCTA Model
18	Willow Pass Rd	North and South	SR 4	Avila Road	1	1	673	1025	1274	582	950	950	0.71	**1.08**	**1.34**	0.61	2000 Count
			Port Chicago Highway	West of Parkside Dr	2	2	398	888	1384	387	1800	1800	0.22	0.49	0.77	0.22	2000 Count
			I-680	Diamond Blvd	3	3	1621	1217	1816	2021	2700	2700	0.60	0.45	0.67	0.75	2000 Count
			Market St	Fry Way	3	3	811	1194	1568	1065	2850	2850	0.28	0.42	0.55	0.37	2000 Count
			Mt. Diablo St	Concord Ave	2	2	493	1005	1322	653	1800	1800	0.27	0.56	0.73	0.36	2000 Count
19	Ygnacio Valley Rd	North and South	Walnut Ave	Wimbledon Rd	3	3	758	876	222	160	2850	2850	0.27	0.31	0.08	0.06	2000 Count
			Oakland Blvd	California Blvd	3	3	2041	1121	1626	2611	2850	2850	0.72	0.39	0.57	0.92	2000 CCTA Model
			Cowell Road	North of Oak Grove Road	2	2	638	2912	2926	865	1900	1900	0.34	**1.53**	**1.54**	0.46	2000 Count
			East of Civic Dr	Walnut Blvd	3	3	1975	2623	3413	1604	2850	2850	0.69	0.92	**1.20**	0.56	2000 Count
			Broadway	Main St	3	3	1632	1857	2013	1911	2700	2700	0.60	0.69	0.75	0.71	2000 Count
20	Imhoff Dr	East & West	Waterbird Way	Solano Way	2	2	124	157	163	120	1900	1900	0.07	0.08	0.09	0.06	2000 Count
21	Clayton Road	East and West	5th St	Davis Avenue	2	2	404	2083	2053	738	1900	1900	0.21	**1.10**	**1.08**	0.39	2000 CCTA Model
			Ayers Road	Ygnacio Valley Rd	3	3	300	1548	1158	546	2700	2700	0.11	0.57	0.43	0.20	2000 CCTA Model
22	Evora Road	East & West	Willow Pass Rd	Driftwood Rd	1	1	151	817	711	322	950	950	0.16	0.86	0.75	0.34	2000 CCTA Model
23	Loveridge Rd	North & South	California Ave	Pittsburg-Antioch Highway	2	2	476	676	716	741	1900	1900	0.25	0.36	0.38	0.39	2000 CCTA Model
			SR 4	Leland Road	2	2	1315	808	1173	1039	1900	1900	0.69	0.43	0.62	0.55	2000 CCTA Model
24	California Ave	East & West	Railroad Ave	Avon Street	1	1	149	476	323	595	800	800	0.19	0.60	0.40	0.74	2000 Count
			SR 4 westbound ramp	Carion Court	1	1	69	526	329	78	800	800	0.09	0.66	0.41	0.10	2000 CCTA Model

Intersection Existing Conditions

Exhibit 16 shows a list of all study intersections, including ramp terminal intersections, as well as key locations away from the freeway to capture any potential diversions. Exhibit 17 illustrates the locations graphically throughout the study area.

A Traffix model was set up to analyze study intersections. A majority of existing intersection counts were collected in 2010 for the CCTA Decennial Model Update Project. A few locations were counted in 2012, along with a few locations counted previously in other recent traffic studies. Intersection LOS was evaluated and reported using the CCTALOS methodology. During the AM and PM peak hours, all 53 intersections operate with LOS D or better, except for two locations:

- At the intersection of SR 242 SB On-Ramp/Commerce Ave and Concord Ave, PM peak hour operates at LOS E.
- At the intersection of Ygnacio Valley Rd and Oak Grove Rd, AM peak hour operates at LOS E.

A summary table of the levels of service is presented in Exhibit 18 and Exhibit 19. Detailed Traffix LOS calculation sheets are included in Appendix A.

Exhibit 16: Analysis Intersections

ID	Intersections	ID	Intersections
1	SR 4 WB On-Ramp & Alhambra Ave	28	Pacheco Blvd & Morello Ave
2	SR 4 EB On-Ramp & Alhambra Ave	29	Pacheco Blvd & Arthur Rd
3	SR 4 WB On-Ramp & Pine St	30	Contra Costa Blvd & Chilpancingo Parkway
4	SR 4 EB On-Ramp & Center Ave	31	Concord Ave & Diamond Blvd
5	SR 4 WB On-Ramp & Morello Ave	32	Contra Costa Blvd & Sunvalley Blvd/Willow Pass Rd
6	SR 4 EB On-Ramp & Morello Ave	33	I-680 NB On-Ramp & Willow Pass Rd
7	SR 4 WB On-Ramp & Pacheco Blvd	34	Diamond Blvd & Willow Pass Rd
8	SR 4 WB On-Ramp/Solano Way & Arnold Industrial Way/Imhoff Dr	35	Willow Pass Rd & Market St
9	SR 4 WB On-Ramp & Port Chicago Hwy	36	Port Chicago Hwy & Olivera Rd
10	SR 4 WB On-Ramp & Willow Pass Rd	37	Port Chicago Hwy & Willow Pass Rd (South)
11	SR 4 EB On-Ramp & San Marco Blvd	38	Willow Pass Rd & Galindo St
12	SR 4 WB On-Ramp & Bailey Rd	39	Port Chicago Hwy & Willow Pass Rd (North)
13	SR 4 EB On-Ramp & Bailey Rd	40	Willow Pass Rd & Bailey Rd
14	SR 4 WB On-Ramp & Railroad Ave	41	Bailey Rd & W Leland Rd
15	SR 4 EB On-Ramp & Railroad Ave	42	Tenth St & Railroad Ave
16	SR 4 WB On-Ramp & California Ave	43	Railroad Ave & Buchanan Rd
17	SR 4 EB On-Ramp & Loveridge Rd	44	Auto Center Dr & W 10th St
18	SR 4 WB On-Ramp & Somersville Rd	45	Buchanan Rd & Somersville Rd
19	SR 4 EB On-Ramp & Somersville Rd	46	Lone Tree Way & Ridgerock Dr/John Donlon Blvd
20	SR 4 WB On-Ramp & A St	47	E 18th St/Main St & Route 160 On-Ramp
21	SR 4 EB On-Ramp & Lone Tree Way	48	Bailey Rd & Concord Blvd
22	SR 4 WB On-Ramp & Hillcrest Ave	49	Clayton Rd & Treat Blvd
23	SR 4 EB On-Ramp & Hillcrest Ave	50	Ygnacio Valley Rd/Kirker Pass Rd & Clayton Rd
24	SR 242 SB On-Ramp & Solano Way	51	Ygnacio Valley Rd & Oak Grove Rd
25	SR 242 SB On-Ramp/Commerce Ave & Concord Ave	52	California Ave & Loveridge Rd
26	SR 242 NB On-Ramp/Market St & Concord Ave	53	W Leland Road & Railroad Ave
27	SR 242 SB On-Ramp & Clayton Rd		

Exhibit 17: Locations of Analysis Intersections

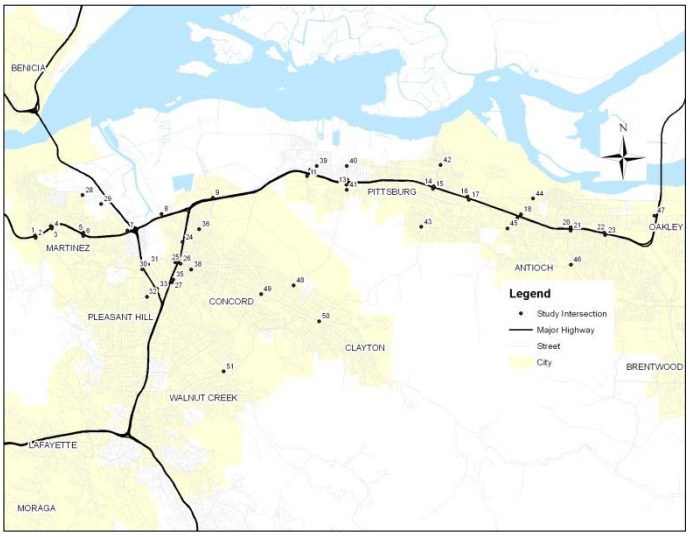


Exhibit 18: Levels of Service Summary of Ramp Intersections

Intersections		Jurisdiction	AM		PM	
			LOS	V/C	LOS	V/C
1	SR 4 WB On-Ramp & Alhambra Ave	Martinez	B	0.65	B	0.65
2	SR 4 EB On-Ramp & Alhambra Ave	Martinez	A	0.49	A	0.48
3	SR 4 WB On-Ramp & Pine St	Martinez	A	0.43	A	0.46
4	SR 4 EB On-Ramp & Center Ave	Martinez	A	0.40	A	0.58
5	SR 4 WB On-Ramp & Morello Ave	Martinez	A	0.42	A	0.42
6	SR 4 EB On-Ramp & Morello Ave	Martinez	A	0.39	A	0.49
7	SR 4 WB On-Ramp & Pacheco Blvd	Martinez	A	0.40	A	0.55
8	SR 4 WB On-Ramp/Solano Way & Arnold Industrial Way/Imhoff Dr	Concord	Currently all-way stop control			
9	SR 4 WB On-Ramp & Port Chicago Hwy	Concord	C	0.77	B	0.69
10	SR 4 WB On-Ramp & Willow Pass Rd	Bay Point	A	0.35	A	0.27
11	SR 4 EB On-Ramp & San Marco Blvd	Bay Point	A	0.33	A	0.47
12	SR 4 WB On-Ramp & Bailey Rd	Pittsburg	C	0.77	C	0.76
13	SR 4 EB On-Ramp & Bailey Rd	Pittsburg	A	0.37	C	0.70
14	SR 4 WB On-Ramp & Railroad Ave	Brentwood	A	0.55	B	0.61
15	SR 4 EB On-Ramp & Railroad Ave	Pittsburg	A	0.55	B	0.66
16	SR 4 WB On-Ramp & California Ave	Pittsburg	A	0.44	C	0.74
17	SR 4 EB On-Ramp & Loveridge Rd	Pittsburg	A	0.55	A	0.60
18	SR 4 WB On-Ramp & Somersville Rd	Antioch	A	0.58	B	0.67
19	SR 4 EB On-Ramp & Somersville Rd	Antioch	A	0.41	B	0.67
20	SR 4 WB On-Ramp & A St	Brentwood	A	0.57	B	0.67
21	SR 4 EB On-Ramp & Lone Tree Way	Antioch	A	0.43	B	0.68
22	SR 4 WB On-Ramp & Hillcrest Ave	Antioch	A	0.50	A	0.57
23	SR 4 EB On-Ramp & Hillcrest Ave	Antioch	A	0.49	B	0.63
24	SR 242 SB On-Ramp & Solano Way	Concord	A	0.52	A	0.45
25	SR 242 SB On-Ramp/Commerce Ave & Concord Ave	Concord	D	0.81	**E**	**0.96**
26	SR 242 NB On-Ramp/Market St & Concord Ave	Concord	A	0.51	B	0.65
27	SR 242 SB On-Ramp & Clayton Rd	Concord	B	0.66	B	0.68

Exhibit 19: Levels of Service Summary of Intersections Away from Freeways

Intersection		Jurisdiction	AM		PM	
			LOS	V/C	LOS	V/C
28	Pacheco Blvd & Morello Ave	Martinez	A	0.59	B	0.62
29	Pacheco Blvd & Arthur Rd	Martinez	A	0.40	A	0.44
30	Contra Costa Blvd & Chilpancingo Parkway	Pleasant Hill	B	0.61	C	0.79
31	Concord Ave & Diamond Blvd	Concord	A	0.37	A	0.56
32	Contra Costa Blvd & Sunvalley Blvd/Willow Pass Rd	Pleasant Hill	A	0.45	B	0.66
33	I-680 NB On-Ramp & Willow Pass Rd	Concord	A	0.51	C	0.75
34	Diamond Blvd & Willow Pass Rd	Concord	A	0.34	A	0.59
35	Willow Pass Rd & Market St	Concord	A	0.50	A	0.60
36	Port Chicago Hwy & Olivera Rd	Concord	B	0.68	C	0.71
37	Port Chicago Hwy & Willow Pass Rd (South)	Concord	A	0.45	A	0.35
38	Willow Pass Rd & Galindo St	Concord	A	0.53	C	0.72
39	Port Chicago Hwy & Willow Pass Rd (North)	Bay Point	B	0.61	A	0.38
40	Willow Pass Rd & Bailey Rd	Bay Point	A	0.45	A	0.57
41	Bailey Rd & W Leland Rd	Bay Point	B	0.68	A	0.51
42	Tenth St & Railroad Ave	Pittsburg	A	0.34	A	0.38
43	Railroad Ave & Buchanan Rd	Pittsburg	B	0.65	A	0.55
44	Auto Center Dr & W 10th St	Antioch	A	0.50	A	0.58
45	Buchanan Rd & Somersville Rd	Antioch	C	0.71	B	0.63
46	Lone Tree Way & Ridgerock Dr/John Donlon Blvd	Antioch	D	0.85	C	0.76
47	E 18th St/Main St & Route 160 On-Ramp	Antioch	A	0.23	A	0.31
48	Bailey Rd & Concord Blvd	Concord	A	0.60	A	0.52
49	Clayton Rd & Treat Blvd	Concord	B	0.68	C	0.74
50	Ygnacio Valley Rd/Kirker Pass Rd & Clayton Rd	Concord	A	0.52	A	0.52
51	Ygnacio Valley Rd & Oak Grove Rd	Walnut Creek	**E**	**0.93**	C	0.79
52	California Ave & Loveridge Rd	Pittsburg	B	0.64	A	0.57
53	W Leland Road & Railroad Ave	Pittsburg	B	0.65	C	0.77

5. FUTURE BASELINE TRAVEL FORECAST AND TRENDS

This chapter describes results for future baseline travel forecast and trends.

5.1. MOBILITIY TRENDS IN STUDY AREA

This section presents trends in area-wide mobility performance measures within the study area. The study area is shown in Exhibit 3 and is generally bounded by Alhambra Avenue to the west, SR 24/Ygnacio Valley Road/Marsh Creek Road to the south, SR 4/former SR 4 by-pass to the east, and Contra Costa County line to the north. Exhibit 20 provides summaries for existing base year, 2015 baseline, 2030 baseline, as well as 2030 unconstrained mobility trends. The 2030 unconstrained scenario includes foreseeable future projects planned for 2030, as described earlier in Chapter 3. As shown in the exhibit, demand is forecasted to increase, travel times, and delays would increase, while speeds would decrease in the future.

Exhibit 20: Study Area Performance Measures Trends

		Study Area						
		VMT	**VHT**	**VHD**	**Mean Speed**	**PMT**	**PHT**	**PHD**
Existing Conditions (2010)								
	AM Peak Hour	781,681	23,267	4,505	33.60	856,804	25,257	4,808
	PM Peak Hour	854,785	24,738	3,759	34.55	968,787	27,923	4,153
	AM Peak 4 Hour	2,389,605	61,881	6,466	38.62	2,615,099	67,273	6,908
	PM Peak 4 Hour	2,894,790	77,099	8,110	37.55	3,280,789	87,048	8,911
2015	**Baseline**							
	AM Peak Hour	899,905	31,953	10,417	28.16	990,691	34,522	11,017
	% Difference	15%	37%	131%	-16%	16%	37%	129%
	PM Peak Hour	978,031	30,943	7,057	31.61	1,111,706	34,764	7,714
	% Difference	14%	25%	88%	-9%	15%	24%	86%
	AM Peak 4 Hour	2,720,947	73,770	10,954	36.88	2,989,407	80,096	11,571
	% Difference	14%	19%	69%	-4%	14%	19%	68%
	PM Peak 4 Hour	3,278,736	90,590	12,849	36.19	3,726,039	102,076	14,059
	% Difference	13%	17%	58%	-4%	14%	17%	58%
2030	**Baseline**							
	AM Peak Hour	1,254,577	58,012	28,151	21.63	1,392,352	62,314	29,641
	% Difference	60%	149%	525%	-36%	63%	147%	516%
	PM Peak Hour	1,347,767	49,558	16,951	27.20	1,540,464	55,287	18,400
	% Difference	58%	100%	351%	-21%	59%	98%	343%
	AM Peak 4 Hour	3,714,973	109,437	24,416	33.95	4,112,329	118,564	25,563
	% Difference	55%	77%	278%	-12%	57%	76%	270%
	PM Peak 4 Hour	4,430,575	131,062	27,066	33.81	5,061,791	147,161	29,503
	% Difference	53%	70%	234%	-10%	54%	69%	231%
2030	**Unconstrained**							
	AM Peak Hour	1,253,493	51,885	22,117	24.16	1,389,593	55,971	23,455
	% Difference	60%	123%	391%	-28%	62%	122%	388%
	PM Peak Hour	1,349,323	45,871	13,406	29.42	1,538,705	51,364	14,706
	% Difference	58%	85%	257%	-15%	59%	84%	254%
	AM Peak 4 Hour	3,726,092	105,257	20,142	35.40	4,118,740	114,261	21,351
	% Difference	56%	70%	211%	-8%	57%	70%	209%
	PM Peak 4 Hour	4,442,021	125,881	22,094	35.29	5,065,897	141,549	24,309
	% Difference	53%	63%	172%	-6%	54%	63%	173%

Note: % Differences are compared to existing conditions.

5.2. STATE ROUTE 4 BOTTLENECK TRENDS – 2015 BASELINE CONDITIONS

This section summarizes 2015 baseline FREQ simulation results for SR 4. A set of calibrated and validated FREQ models were developed for SR 4 eastbound and westbound directions as part of the recently completed CSMP study. The validated FREQ12 model was then applied to the projected volumes for 2015 conditions. This section summarizes the performance measures, congestion locations, bottlenecks, and causes along the corridor.

In general, this analysis finds that even with the committed improvements that were included in this analysis (as described in Chapter 3), congestion along SR 4 is expected to significantly worsen between 2007 and 2015. Exhibit 21 provides a comparison of projected daily traffic along key locations of the corridor. Detailed forecast results are included in Appendix B.

- **Peak Hour Vehicle Demand**: While not a strict performance measure, estimates of vehicle demand drive the remainder of the measures summarized in the following discussion for the SR 4 Corridor. Today, peak hour demand on SR 4 is 7,600 vph in the morning, westbound direction of travel and 7,800 vph in the afternoon, eastbound direction of travel. By 2015, these demands are estimated to be 10,000 vph and 8,400 vph, respectively – an increase of between 7% and 30% in peak hour travel demand in the SR 4 Corridor.[16]
- **Peak Hour Travel Speed**: Peak hour travel speeds throughout the corridor are projected to deteriorate even with the committed improvement identified. Today, the average peak hour speed in the morning, westbound direction of travel is 28 mph and evening eastbound direction of travel is 38 mph. By 2015, the peak hour speed is projected to be 25 mph in the westbound direction and 31 mph in the eastbound direction due to increased demands and the resulting congestion on SR 4.
- **Peak Hour Travel Time**: Today it is estimated to take 1 hour and 7 minutes to travel the 33-mile SR 4 Corridor end to end in the westbound direction during the morning peak hour and 49 minutes to travel in the eastbound direction during the evening peak hour. With the increased travel demands and projected decreases in travel speeds, this same 33-mile trip is projected to take over 1 hour and 20 minutes in the westbound direction and over 1 hour 6 minutes in the eastbound direction by 2015.
- **Total Delay:** This measure is based on the difference between projected travel speeds along the corridor and free-flow speeds (60 mph). Delay in the SR 4 corridor eastbound and westbound combined is projected to increase by approximately 86% from 8,100 hours per day in 2007 to 15,100 hours in 2015.

Exhibit 22 and Exhibit 23 provide summaries of performance measures along SR 4 during the peak hour and peak period, respectively.

[16] Traffic demands are between Willow Pass (East) and Willow Pass (West) Interchanges for both peak hours reported.

Exhibit 21: Comparison of Existing and Projected Average Weekday Traffic Volumes on SR 4

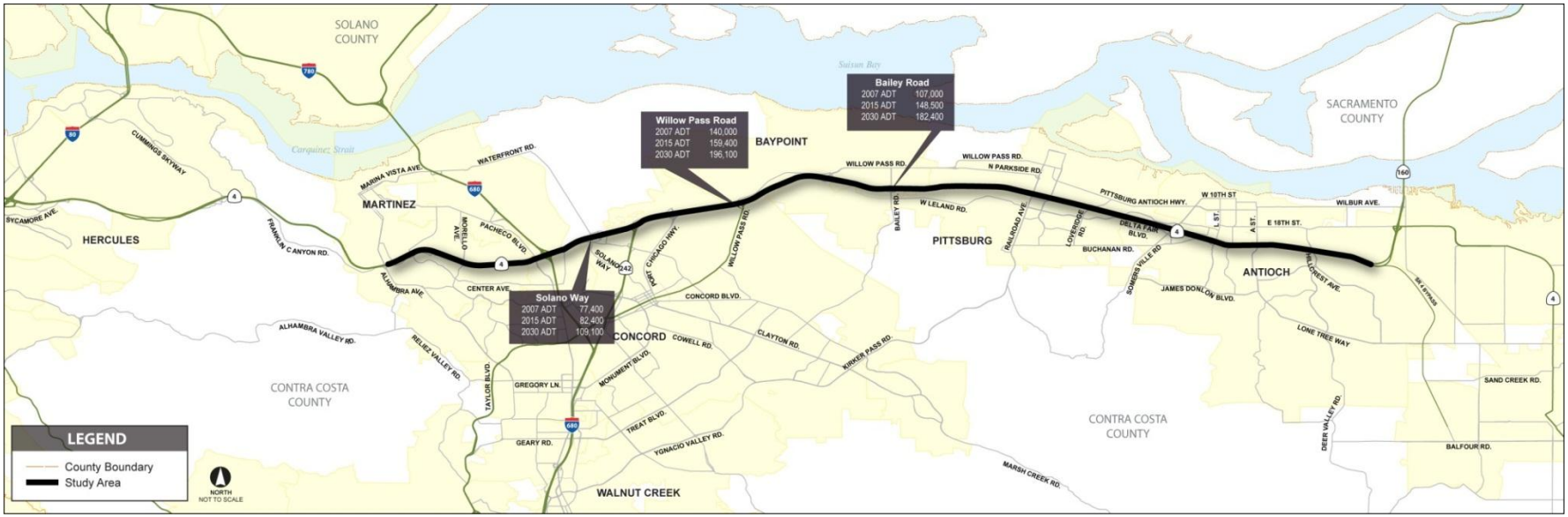


Exhibit 22 - Existing and Future Performance Measures on SR 4 – Peak Hour

Measure	Westbound - AM Peak Hour (8:00 – 9:00 AM)		Eastbound - PM Peak Hour (5:00 – 6:00 PM)	
	Existing	2015	Existing	2015
Veh. Hours of Travel (VHT)	3,700	5,300	3,000	3,900
Veh. Miles of Travel (VMT)	91,000	111,000	118,000	132,000
Average Speed (mph)	28 (HOV: 40)	25 (HOV: 49)	38 (HOV: 45)	31 (HOV: 32)
Corridor Travel Time (h:mm)	1:07 (HOV: 0:47)	1:20 (HOV: 0:41)	0:49 (HOV: 0:42)	1:06 (HOV: 1:04)
Total Delay (VHD for speeds less than 60 mph)	2,180	3,440	1,040	1,780
Congestion Delay (VHD for speeds less than 35 mph)	1,690	2,730	690	1,400

Exhibit 23 - Existing and Future Performance Measures on SR 4 – Peak Period

Measure	Westbound - AM Peak Period (6:00 – 10:00 AM)		Eastbound - PM Peak Period (3:00 – 7:00 PM)	
	Existing	2015	Existing	2015
Veh. Hours of Travel (VHT)	11,000	16,500	10,200	12,100
Veh. Miles of Travel (VMT)	359,000	446,000	444,000	532,000
Average Speed (mph)	38 (HOV: 45)	34 (HOV: 53)	43 (HOV: 47)	44 (HOV: 45)
Average Corridor Travel Time (h:mm)	0:53 (HOV: 00:42)	1:05 (HOV: 0:38)	0:44 (HOV: 0:40)	0:49 (HOV: 0:47)
Total Delay (VHD for speeds less than 60 mph)	5,170	9,270	2,980	3,580
Congestion Delay (VHD for speeds less than 35 mph)	3,720	7,000	1,900	2,430

In 2015, for the westbound direction of travel in the morning peak period, the duration of the bottleneck and associated queuing that is present today between the Willow Pass Road and Port Chicago Highway interchanges in the vicinity of the westbound HOV lane drop (Location 2) is projected to continue and worsen. This location is a four-lane section (three mixed-flow lanes plus one HOV lane), which is projected to provide inadequate capacity to accommodate the demand. Additionally, HOVs exiting at SR 242 or entering at Willow Pass Road crossing the mixed-flow lanes will contribute to the congested conditions. The westbound bottleneck between the Willow Pass Road and Port Chicago Highway interchanges is projected to develop between 6 AM and 7 AM and would last for about 5 hours, 1 hour longer than existing conditions. The other westbound bottleneck that is present today between Somersville Road and Loveridge Road is not projected to be present in

2015 because of programmed freeway widening. A new westbound bottleneck is projected to develop by 2015 between the Solano Way and I-680 interchanges (Location 1) as a result of increased demand on the two-lane segment approaching the I-680 Interchange. The bottleneck between the Solano Way and I-680 interchanges is projected to develop between 6 AM and 7 AM and would last for about 2 hours.

For the eastbound direction in the afternoon peak period, the existing bottleneck between SR 242 and Port Chicago shifts east to a new location between Port Chicago Highway and Willow Pass Road West. This bottleneck would result in maximum queues extending about 6 miles west to Morello Avenue, embedding the existing bottleneck between SR 242 and Port Chicago Highway at the onset of congestion around 3 PM and reaching the I-680 to Solano Way bottleneck by 5 PM. In total, congestion approaching this bottleneck would occur for about 4.75 hours, about a 2.75 hour increase in congestion duration compared to existing conditions. The easterly existing bottleneck between Loveridge Road and Somersville Road would not be expected to develop in 2012 due to the programmed freeway widening through that section.

Additional information on the peak hour condition of these bottlenecks is presented in Exhibit 24 and depicted graphically in Exhibit 25.

Exhibit 24: Locations and Causes of Congestion on SR 4 in 2015

Location	Bottleneck Description	Cause	Max. Queue Length (mi./Peak Period)	Avg. Speed (mph/Peak Period)	Total Delay (Veh·Hrs/Peak Period)
1	2015 Westbound, AM Peak Between Solano Way and Interstate 680	This bottleneck is projected to develop between the interchanges of Solano Way and I-680. The bottleneck is the two-lane mixed-flow section that provides inadequate capacity to accommodate the projected demand. Congestion is projected to extend about 2 miles and dissipates in the vicinity of Port Chicago Highway.	2.0	36	1,200
2	2015 Westbound, AM Peak Between Willow Pass Road and Port Chicago Hwy	This bottleneck is projected to develop at the same location as in the existing condition, between the Willow Pass Road and Port Chicago Highway interchanges. This location is a four-lane section (three mixed-flow lanes plus one HOV lane), which provides inadequate capacity to accommodate the projected demand. HOVs exiting at SR 242 or entering at Willow Pass Road crossing the mixed- flow lanes, will contribute to the congested conditions. The existing queue in 2007 that extends approximately 6 miles east to between Loveridge Road and Railroad Avenue is projected to lengthen in 2015 to extend 10 miles to between L Street and Somersville Road.	10.0	23	7,900
3	2015 Eastbound, PM Peak Between Port Chicago Highway and Willow Pass Road	This controlling bottleneck is projected to develop between the Port Chicago Highway and Willow Pass Road interchanges at a four-lane roadway section consisting of three-mixed flow lanes and one HOV lane. This segment provides inadequate capacity to accommodate the projected demand. Queues caused by this bottleneck are projected to extend 6 miles west to Morello Avenue.	6.5	27	3,300

Exhibit 25: Locations of Bottlenecks and Recurrent Congestion on SR 4 in 2015

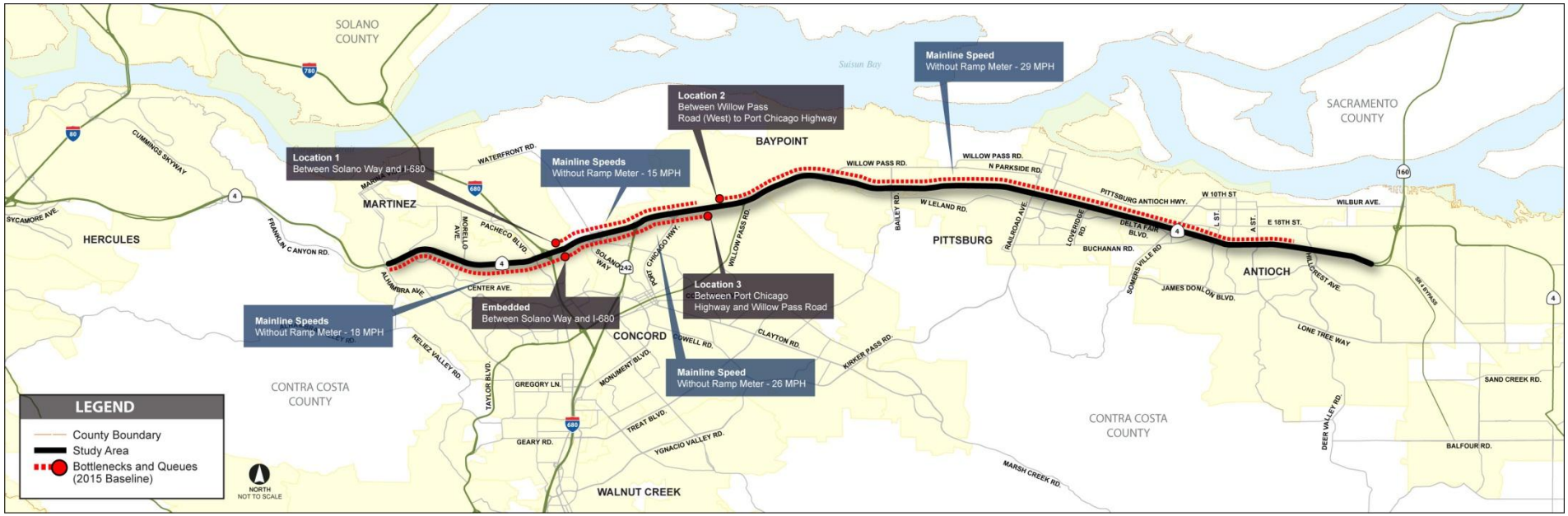


Exhibit 26 provides a comparison of travel times in the mixed-flow lanes between existing conditions and 2015 baseline conditions for the SR 4 corridor. As shown in the exhibit, during the AM peak hour, westbound travel time is expected to increase by about 19 minutes, or approximately 28%. While during the PM peak hour, eastbound travel time is expected to increase by about 23 minutes, or approximately 67%. Note that for the eastbound direction between 3 PM and 5 PM, travel times would be improved with the implementation of planned freeway improvements by 2015.

Exhibit 26: Travel Time Comparisons for SR 4

	Start Time	End Time	2015 (Minutes)	Existing (Minutes)	Difference	
					(mins)	%
Westbound	6:00 AM	7:00 AM	26.2	25.2	1.0	4%
	7:00 AM	8:00 AM	47.9	39.0	8.9	18%
	8:00 AM	9:00 AM	68.4	57.1	11.3	16%
	9:00 AM	10:00 AM	68.7	49.5	19.2	28%
	Average		52.8	42.7	10.1	19%
Eastbound	3:00 PM	4:00 PM	23.6	27.1	-3.5	-13%
	4:00 PM	5:00 PM	28.6	35.8	-7.2	-20%
	5:00 PM	6:00 PM	42.4	39.0	3.5	9%
	6:00 PM	7:00 PM	57.9	34.7	23.2	67%
	Average		38.1	34.1	4.0	12%

Note: Travel times represent traveling through the study limits between the Alhambra Avenue interchange to SR 160 interchange, an overall distance of approximately 21 miles.

5.3. STATE ROUTE 242 BOTTLENECK TRENDS – 2015 BASELINE CONDITIONS

This section summarizes 2015 baseline FREQ simulation results for SR 242. A set of calibrated and validated FREQ models were developed for SR 242 northbound and southbound directions. The validated FREQ12 model was then applied to the projected volumes for 2015 conditions. This section summarizes the performance measures, congestion locations, bottlenecks, and causes along the corridor.

With future travel demand increases, congestion along SR 242 is expected to worsen between existing conditions and Year 2015. However, the amount of throughput delivered to SR 242 connector from SR 4 westbound during the AM peak period would be constrained by queues extending from the new Solano Way bottleneck location. The constrained throughput to SR 242 southbound would be less than existing volumes and would therefore lessen existing queuing effects at the I-680 SB merge bottleneck. Exhibit 27 provides a comparison of projected daily traffic along key locations of the corridor. Detailed forecast results are included in the Appendix C.

- **Peak Hour Vehicle Demand**: Existing peak hour demand on SR 242 is 5,740 vph in the morning southbound direction (between Solano Way on-ramp and Concord Avenue off-ramp) and 5,035 vph in the afternoon northbound direction (between Concord Avenue on-ramp and Solano Way off-ramp). By 2015, these demands are estimated to be 5,980 vph and 6,360 vph, respectively—an increase of between 4% and 6% in the peak hour along the SR 242 Corridor.
- **Peak Hour Travel Speed**: In the northbound direction, the average corridor peak hour speed would decrease from 60 mph to 40 mph. In the southbound direction, due to constrained volumes entering from WB SR 4, the average corridor peak hour speed would increase from 49 mph to 64 mph.
- **Peak Hour Travel Time**: Corridor travel times are expected to decrease during the peak hour, from 5.8 minutes to 4.4 minutes for the southbound direction in the AM peak hour, and would increase from 3.9 to 7.6 minutes for the northbound direction in the PM peak hour.
- **Total Delay:** Vehicle hours of delay during the AM peak hour would decrease from 114 to 6, while it would increase from 25 to 189 during the PM peak hour.

Exhibit 28 and Exhibit 29 provide summaries of performance measures along SR 242 during the peak hour and peak period, respectively.

Exhibit 27: Comparison of Existing and Projected Average Weekday Traffic Volumes on SR 242

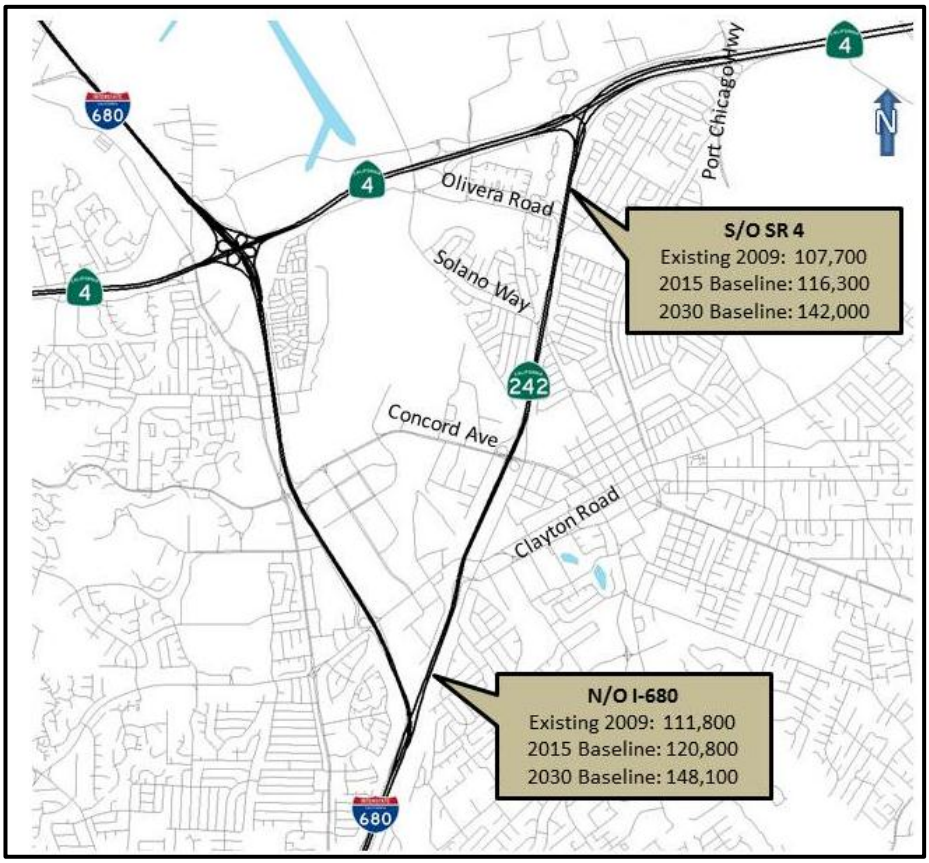


Exhibit 28 - Existing and Future Performance Measures on SR 242 – Peak Hour

Measure	Southbound - AM Peak Hour (6:00 – 7:00 AM)		Northbound - PM Peak Hour (5:00 – 6:00 PM)	
	Existing	2015	Existing	2015
Veh. Hours of Travel (VHT)	461	334	317	495
Veh. Miles of Travel (VMT)	22,490	21,290	19,018	19,971
Average Speed (mph)	49	64	60	40
Corridor Travel Time (minutes)	5.8	4.4	3.9	7.6
Veh. Hours of Delay (VHD)	114	6	25	189

Exhibit 29 - Existing and Future Performance Measures on SR 242 – Peak Period

Measure	Southbound - AM Peak Period (6:00 – 10:00 AM)		Northbound - PM Peak Period (3:00 – 7:00 PM)	
	Existing	2015	Existing	2015
Veh. Hours of Travel (VHT)	1,515	1,217	1,094	1,587
Veh. Miles of Travel (VMT)	83,845	87,256	68,335	72,390
Average Speed (mph)	55	64	62	46
Corridor Travel Time (minutes)	5.0	4.4	3.8	5.2
Veh. Hours of Delay (VHD)	221	7	45	475

Year 2015 baseline freeway bottleneck and queues affecting SR 242 are described as follows:

- **SR 242 Southbound AM Peak Period:** Similar to existing conditions, congestion would continue to occur on southbound I-680 south of the merge of SR 242 southbound. However, as described in earlier text, due to constrained volumes from westbound SR 4 reaching southbound SR 242, there would be little queuing on SB SR 242.
- **SR 242 Northbound PM Peak Period:** Similar to existing conditions, queues from the bottleneck on eastbound SR 4 east of the SR 242 merge would cause queues to extend onto northbound SR 242 as far south as the Solano Way interchange. Congestion would begin at about 5 PM and would dissipate by approximately 7 PM (duration of congestion beyond 7 PM is estimated based on existing volume profiles between 6 PM and 8 PM).

Exhibit 30 provides a summary of performance measures associated with the bottlenecks, and Exhibit 31 provides a graphical illustration of queues.

Exhibit 30: Bottlenecks Affecting SR 242 for Year 2015 Baseline

Loc.	Bottleneck Description	Cause	Max. Queue Length (mi./Peak Period)	Avg. Speed (mph/during congestion)	Total Delay (Veh-Hours/ during congestion)
1	2015 Southbound, AM Peak Period SB I-680 South of the I-680/SR 242 merge	Minor congestion on the SB 242 connector to SB I-680	0	64	7
2	2015 Northbound, PM Peak Period EB SR4 east of the SR4/SR 242 merge	Congestion extending as far south as the Solano Way interchange	1.6	26	392

Exhibit 31: Graphics Illustration of 2015 Bottleneck on SR 242

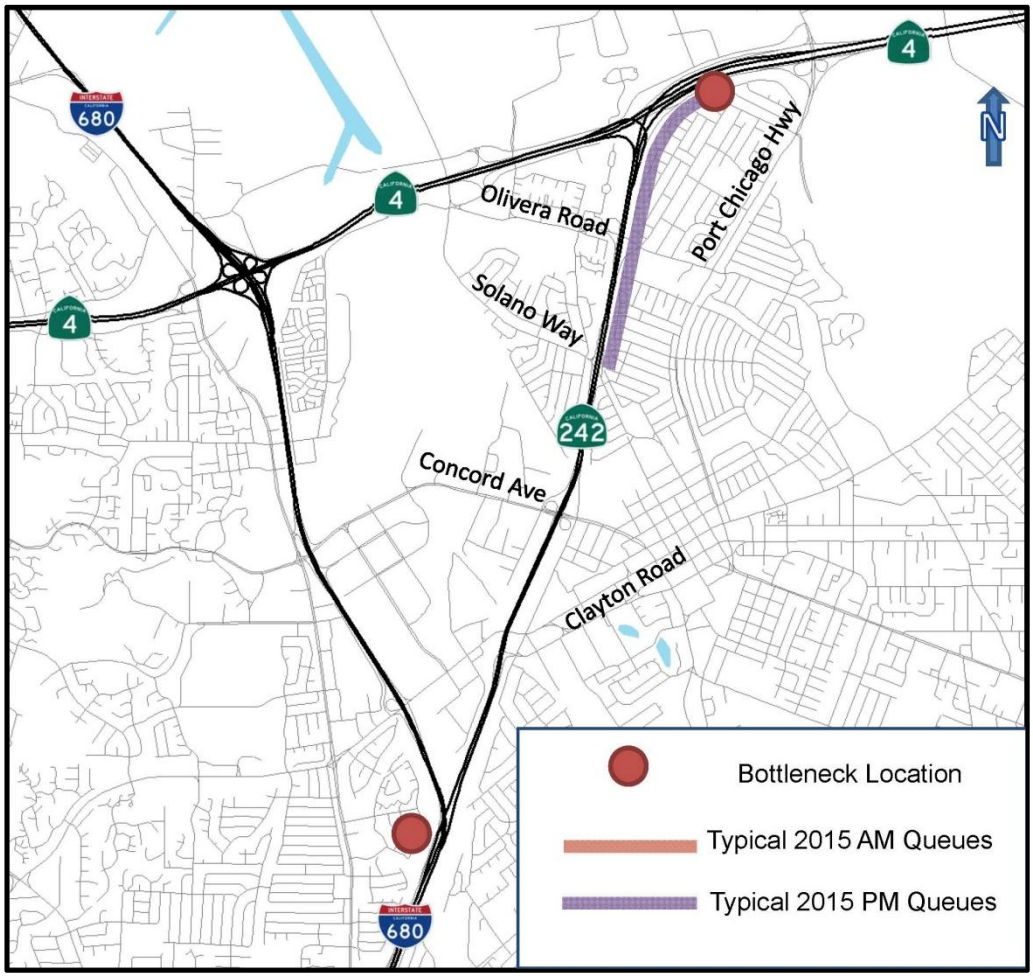


Exhibit 32 provides a comparison of travel times between existing conditions and 2015 baseline conditions for the SR 242 corridor, southbound direction during AM peak period, and northbound direction during PM peak period. As shown in the exhibit, during the AM peak hour, southbound travel time is expected to decrease by about 1 minute. While during the PM peak hour, northbound travel time is expected to increase by about 3.7 minutes, or approximately 93%.

Exhibit 32: Travel Time Comparisons for SR 242

	Start Time	End Time	2015 (minutes)	Existing (minutes)	Difference	
					(mins)	%
Southbound	6:00 AM	7:00 AM	4.4	5.8	-1.3	-23%
	7:00 AM	8:00 AM	4.4	5.6	-1.3	-22%
	8:00 AM	9:00 AM	4.4	4.4	0.0	-1%
	9:00 AM	10:00 AM	4.4	4.4	0.0	0%
	Average		4.4	5.0	-0.7	-13%
Northbound	3:00 PM	4:00 PM	3.7	3.6	0.0	1%
	4:00 PM	5:00 PM	3.7	3.6	0.0	1%
	5:00 PM	6:00 PM	6.1	3.9	2.2	55%
	6:00 PM	7:00 PM	7.6	3.9	3.7	93%
	Average		5.2	3.8	1.5	39%

Note: Travel times represent traveling through the entire length of SR 242 in both directions, from I-680 in the south, to SR 4 in the north, approximately 3.9 miles in the northbound, and 4.7 miles in the southbound direction.

5.4. YEAR 2015 BASELINE TRENDS OF OTHER FREEWAYS, ARTERIALS, AND INTERSECTIONS

This section describes Year 2015 future baseline trends of other freeway corridors, arterials, and intersections within the study area, where ramp metering may impact facilities.

Other Freeways – 2015 Baseline Conditions

The baseline conditions data for other freeway segments are included Exhibit 33.

I-680

Year 2015 baseline conditions analysis on I-680 are summarized as follows:

- **I-680 Southbound:** During AM peak hour, v/c ratios would vary from 0.81 to 0.93. A higher v/c ratio would occur at the northern section of the freeway between SR 4 and Pacheco Boulevard. During the PM peak hour, v/c ratios would vary from 0.73 to 1.0. A greater v/c ratio would occur at the southern section of the freeway between SR 242 and south of Willow Pass Road. Traffic volume during AM Peak period would vary from 4,800 to 6,100 vph and from 4,500 to 5,700 vph during the PM peak hour.
- **I-680 Northbound:** During AM peak hour, v/c ratios would vary from 0.63 to 0.87. V/c ratios would be higher at the southern section of the freeway between SR 242 and south of Willow Pass Road. During the PM peak hour, v/c ratios would vary from 0.72 to 0.87. V/c ratios would be higher toward the northern section of the freeway between SR 4 and Pacheco Boulevard. Traffic volume during AM peak hour would vary from 4,400 to 5,000 vph and from 4,500 to 5,500 vph during the PM peak hour.

SR 160

Year 2015 baseline conditions analysis on SR 160 are summarized as follows:

- **SR 160 Southbound:** During both AM and PM peak hours, the v/c ratios would vary from 0.10 to 0.20. Traffic volume during AM peak hour would vary from 400 to 600 vph and from 500 to 800 vph during the PM Peak period.
- **SR 160 Northbound:** During both AM and PM peak hours, the v/c ratio would vary from 0.12 to 0.21. Traffic volume during AM Peak period would vary from 500 to 800 vph and would vary from 500 to 600 vph during the PM Peak period.

SR 4 East of SR 160

2015 baseline conditions analysis on SR 4 east of SR 160 are summarized as follows:

- **Southbound:** The v/c ratio would be 0.29 during the AM peak hour and 0.40 during the PM peak hour. Traffic volumes would be 1100 vph and 1600 vph for AM and PM peak hours respectively.
- **Northbound:** The v/c ratio would be 0.83 during the AM peak hour and 0.81 during PM peak hour. Traffic volumes would be approximately 3,300 vph for both the AM and PM peak hours.

Exhibit 33: Other Adjacent Freeway Segments – 2015 Baseline Conditions Analysis

Freeway	From	To	Lanes		AM Peak Volume (vph)		PM Peak Volume (vph)		Capacity (vph)		AM v/c		PM v/c	
			NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB
I-680	Pacheco Blvd	Arthur Road	3	3	4416	4996	4527	4534	5850	5850	0.75	0.85	0.77	0.78
	North of Willow Pass Road	South of Concord Ave	4	4	4750	6141	5506	5537	7600	7600	0.63	0.81	0.72	0.73
	Pacheco Blvd	SR 4	3	3	4895	5313	4938	4997	5700	5700	0.86	0.93	0.87	0.88
	North of Concord Ave	SR 4	3	3	4941	5101	5013	5385	5850	5850	0.84	0.87	0.86	0.92
	SR-242	South of Willow Pass Road	3	3	4984	4830	4778	5706	5700	5700	0.87	0.85	0.84	1.00
SR 160	Foot of Bridgehead Road	South of Wilbur Ave	2	2	481	402	493	536	3900	3900	0.12	0.10	0.13	0.14
	North of 18th Street	North of Oakley Road	2	2	813	612	603	781	3900	3900	0.21	0.16	0.15	0.20
SR 4 E/O SR 160	Lone Tree Way	Laurel Road	2	2	3339	1142	3259	1608	4000	4000	0.83	0.29	0.81	0.40

2015 Baseline conditions arterial analysis

2015 baseline conditions data for arterials are included in Exhibit 34. The following is a list of the segments with v/c more than 1.0, which are also highlighted in the exhibit:

- 10th Street
  - Between H Street and G Street:
    - Westbound direction: AM peak v/c ratio would be 1.13
    - Eastbound direction: PM peak v/c would be 1.10
  - Between L Street and K Street
    - Westbound direction: AM peak v/c ratio would be 1.17
    - Eastbound direction: PM peak v/c ratio would be 1.15
  - Between K Street and H Street
    - Westbound direction: AM peak v/c ratio would be 1.17
    - Eastbound direction: PM peak v/c ratio would be 1.14
- 18th Street
  - Between A Street and Alpha Way
    - Westbound direction: AM peak v/c ratio would be 1.10
  - Between Alpha Way and Crestwood Drive
    - Westbound direction: AM peak v/c ratio would be 1.09
    - Eastbound direction: PM peak v/c ratio would be 1.01
  - Between Crestwood Drive and Cavallo Road
    - Westbound direction: AM peak v/c ratio would be 1.20
    - Eastbound direction: PM peak v/c ratio would be 1.14
- Bailey Road
  - Between SR 4 and Canal Road
    - NB direction: PM peak v/c would be 1.22
- Buchanan Road
  - Between Railroad Eastbound and west of Book Side Drive
    - Westbound direction: AM peak v/c would be 1.39
    - Eastbound direction: PM peak v/c would be 1.27
  - Between Meadows Eastbound and Somersville Road
    - Westbound direction: AM peak v/c would be 1.51
    - Eastbound direction: PM peak v/c would be 1.54
  - Between Loveridge Road and Mcfaul Drive
    - Westbound direction: AM peak v/c ratio would be 1.03
  - Between Railroad Eastbound and Brookside Drive
    - Westbound direction: AM peak v/c ratio would be 1.07
- Contra Costa Boulevard

- Between 2nd Eastbound and Center Eastbound
  - SB direction: AM peak v/c ratio would be 1.09
  - NB direction: PM peak v/c ratio would be 1.03

- E 18th Street
  - Between Cavallo Road and Biglow Drive
    - Westbound direction: AM peak v/c ratio would be 1.18
    - Eastbound direction: PM peak v/c ratio would be 1.12
- Kirker Pass Road
  - Between Castlewood Drive and Pheasant Drive
    - SB direction: AM peak v/c ratio would be 1.11
- Leland Road
  - Between Willow Eastbound and Bailey Road
    - Eastbound direction: PM peak v/c ratio would be 1.27
- Pacheco Boulevard
  - Between Blum Road and Arnold Drive
    - SB direction: AM peak v/c ratio would be 1.11
    - NB direction: PM peak v/c ratio would be 1.20
- Pittsburg-Antioch Highway
  - Between Verne Roberts Cir and Auto Center Drive
    - Eastbound direction: AM peak v/c would be 1.19
    - Westbound direction: PM peak v/c would be 1.31
  - Between Loveridge Road and Columbia Street
    - Westbound direction: AM peak v/c ratio would be 1.04
  - Between Loveridge Road and California Eastbound
    - Westbound direction: AM peak v/c would be 1.71
    - Eastbound direction: PM peak v/c would be 1.52
- Treat Boulevard
  - Between Sheppard Road and Cherry Ln
    - Westbound direction: AM peak v/c ratio would be 1.20
    - Eastbound direction: PM v/c ratio would be 1.39
- Willow Pass Road
  - Between SR 4 and Avila Road
    - SB direction: AM peak v/c ratio would be 1.08
    - NB direction: PM peak v/c ratio would be 1.34
- Ygnacio Valley Road
  - Between Cowell Road and north of Oak Grove Road
    - SB direction: AM peak v/c would be 1.68
    - NB direction: PM peak v/c would be 1.67

- Between East of Civic Drive and Walnut Boulevard
  - NB direction: PM peak v/c would be 1.20

- Clayton Road
  - Between 5th Street and Davis Avenue
    - Westbound direction: AM peak v/c would be 1.16
    - Eastbound direction: PM peak v/c would be 1.13

- Evora Road
  - Between Willow Pass Road and Driftwood Road
    - Westbound direction: AM peak v/c ratio would be 1.20

Exhibit 34: Arterial 2015 Baseline Conditions Analysis

No.	Name	Direc-tion	Cross Street 1	Cross Street 2	Lanes		AM Peak Volume (vph)		PM Peak Volume (vph)		Capacity (vph)		AM v/c		PM v/c	
					NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB
1	10th St	East and West	H St	G St	1	1	91	1074	1049	256	950	950	0.10	**1.13**	**1.10**	0.27
			L St	K St	1	1	117	1107	1093	305	950	950	0.12	**1.17**	**1.15**	0.32
			K St	H St	1	1	86	1051	1023	248	900	900	0.10	**1.17**	**1.14**	0.28
2	18th St	East and West	A St	Alpha Way	1	1	150	1042	953	243	950	950	0.16	**1.10**	1.00	0.26
			Alpha Way	Crestwood Dr	1	1	173	1037	962	286	950	950	0.18	**1.09**	**1.01**	0.30
			Crestwood Dr	Cavallo Road	1	1	214	1137	1084	371	950	950	0.23	**1.20**	**1.14**	0.39
3	9th St	East and West	C St	D St	1	1	26	158	166	58	700	700	0.04	0.23	0.24	0.08
			A St	C St	1	1	38	203	229	87	700	700	0.05	0.29	0.33	0.12
4	Alhambra Ave	North and South	Alhambra Valley Road	Kim Ct	1	1	557	696	763	776	950	950	0.59	0.73	0.80	0.82
			North of SR 4	North of Walnut Ave	2	2	1734	1260	1411	1740	1800	1800	0.96	0.70	0.78	0.97
			Franklin Canyon Road	South of SR 4	1	1	555	677	697	648	950	950	0.58	0.71	0.73	0.68
5	Bailey Rd	North and South	Leland Rd	Maylard St	2	3	1710	713	898	1938	1800	2700	0.95	0.26	0.50	0.72
			Willow Pass Road	Placer Dr	2	2	611	667	745	665	1900	1900	0.32	0.35	0.39	0.35
			North of Maylard St	S of SR 4 (S of On-ramp)	2	3	1567	1543	1621	1566	1800	2700	0.87	0.57	0.90	0.58
			North of SR 4	Canal Road	2	2	1909	977	2315	1116	1900	1900	1.00	0.51	**1.22**	0.59
6	Buchanan Rd	East and West	Railroad Ave	West of Book Side Dr	1	1	450	1319	1203	679	950	950	0.47	**1.39**	**1.27**	0.71
			Somersville Road	West of Gentrytown Dr	2	2	261	867	973	387	1900	1900	0.14	0.46	0.51	0.20
			Del Oro Cir	Contra Loma Blvd	2	2	85	1416	1354	490	1900	1900	0.04	0.75	0.71	0.26
			East of Meadows Ave	Somersville Road	1	1	522	1431	1465	570	950	950	0.55	**1.51**	**1.54**	0.60
			Loveridge Road	Mcfaul Dr	1	1	479	977	933	834	950	950	0.50	**1.03**	0.98	0.88
			East of Railroad Ave	Brookside Dr	1	1	317	1018	886	637	950	950	0.33	**1.07**	0.93	0.67
7	Contra Costa Blvd	North and South	Chilpancingo Pkwy	North of Golf Club Rd	2	2	552	933	1783	1331	1900	1900	0.29	0.49	0.94	0.70
			North of Hookston Rd	Boyd Rd	2	2	612	1750	1905	1113	1900	1900	0.32	0.92	1.00	0.59
			Harriet Dr	Taylor Blvd	2	2	737	1178	1912	1521	1960	1960	0.38	0.60	0.98	0.78
			2nd Ave	Center Ave	2	2	645	2127	2027	1415	1960	1960	0.33	**1.09**	**1.03**	0.72
			Oak Park Blvd	North of Oakpark Blvd	2	2	305	1570	841	693	1900	1900	0.16	0.83	0.44	0.36
8	E 18th St	East and West	West of SR 160	Phillips Ln	1	1	179	383	531	359	950	950	0.19	0.40	0.56	0.38
			Cavallo Road	Biglow Dr	1	1	203	1117	1064	361	950	950	0.21	**1.18**	**1.12**	0.38
			Vineyard Dr	Willow Ave	1	1	151	597	656	226	950	950	0.16	0.63	0.69	0.24
9	Hillcrest Ave	North & South	Interchange (North of SR 4)	SR 4	3	3	2004	471	1569	637	2700	2700	0.74	0.17	0.58	0.24
			South of Larkspur Dr	North of Davison Dr	3	3	2384	973	1401	2404	2700	2700	0.88	0.36	0.52	0.89
10	James Donlon Blvd	East and West	Contra Loma Blvd	Blythe Dr	2	2	152	816	965	257	1900	1900	0.08	0.43	0.51	0.14
			S Royal Links Cir	Lone Tree Way	2	2	496	1018	1208	717	1900	1900	0.26	0.54	0.64	0.38

No.	Name	Direc-tion	Cross Street 1	Cross Street 2	Lanes		AM Peak Volume (vph)		PM Peak Volume (vph)		Capacity (vph)		AM v/c		PM v/c	
					NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB
11	Kirker Pass Rd	North and South	Concord Blvd	Kirkwood Dr	3	3	675	2435	2560	888	2850	2850	0.24	0.85	0.90	0.31
			Nortonville Rd	North of Hess Rd	2	2	560	2019	1454	849	1900	1900	0.29	**1.06**	0.77	0.45
			Castlewood Dr	Pheasant Dr	2	2	750	1997	1514	1057	1800	1800	0.42	**1.11**	0.84	0.59
12	Leland Rd	East and West	Railroad Ave	West of Presidio Ln	2	2	605	1264	1608	870	1900	1900	0.32	0.67	0.85	0.46
12	Leland Rd	East and West	Crestview Dr	Railroad Ave	2	2	662	1113	1480	821	1900	1900	0.35	0.59	0.78	0.43
			John Johnson Pkwy	West of Golf Club Rd	2	2	304	1492	989	421	1900	1900	0.16	0.79	0.52	0.22
			Willow Ave	Bailey Rd	2	2	323	1877	2405	656	1900	1900	0.17	0.99	**1.27**	0.35
13	Lone Tree Wy	North and South	Worrell Rd	Hillside Rd	2	2	1648	402	724	1660	1900	1900	0.87	0.21	0.38	0.87
			South of Clearbrook Rd	Davison Dr	2	2	1564	350	646	1555	1800	1800	0.87	0.19	0.36	0.86
14	Pacheco Blvd	North and South	Blum Road	South of Arnold Dr	1	1	678	1000	1077	889	900	900	0.75	**1.11**	**1.20**	0.99
			Muir Rd	Buchanan Cir	2	2	441	599	816	679	1900	1900	0.23	0.32	0.43	0.36
			1st Ave	Center Ave	2	2	581	1569	1470	1218	1900	1900	0.31	0.83	0.77	0.64
15	Pittsburg-Antioch Hwy	East and West	Verne Roberts Cir	Auto Center Dr	1	1	1126	479	702	1248	950	950	**1.19**	0.50	0.74	**1.31**
			Loveridge Road	Columbia St	1	1	258	983	914	297	950	950	0.27	**1.04**	0.96	0.31
			Loveridge Road	California Ave	1	1	217	1620	1447	562	950	950	0.23	**1.71**	**1.52**	0.59
16	Somersville Rd	North and South	Century Blvd	Sycamore Dr	3	3	733	851	1687	1580	2700	2700	0.27	0.32	0.62	0.59
			Delta Fair Blvd	Fairview Dr	2	2	538	149	243	479	1800	1800	0.30	0.08	0.14	0.27
17	Treat Blvd	East and West	I-680	Oak Rd	3	3	1282	2192	2061	1837	2850	2850	0.45	0.77	0.72	0.64
			East of Oak Grove Rd	Blarney Ave	3	3	285	2373	1817	694	2850	2850	0.10	0.83	0.64	0.24
			Sheppard Rd	Cherry Ln	3	3	1926	3515	4073	2480	2940	2940	0.66	**1.20**	**1.39**	0.84
			Arkell Rd	Winton Dr	3	3	553	2459	1921	1087	2850	2850	0.19	0.86	0.67	0.38
18	Willow Pass Rd	North and South	SR 4	Avila Road	1	1	821	1025	1274	730	950	950	0.86	**1.08**	**1.34**	0.77
			Port Chicago Highway	West of Parkside Dr	2	2	505	990	1561	428	1800	1800	0.28	0.55	0.87	0.24
			I-680	Diamond Blvd	3	3	1747	1357	1848	2066	2700	2700	0.65	0.50	0.68	0.77
			Market St	Fry Way	3	3	913	1299	1720	1098	2850	2850	0.32	0.46	0.60	0.39
			Mt. Diablo St	Concord Ave	2	2	577	1154	1460	709	1800	1800	0.32	0.64	0.81	0.39
19	Ygnacio Valley Rd	North and South	Walnut Ave	Wimbledon Rd	3	3	835	952	264	249	2850	2850	0.29	0.33	0.09	0.09
			Oakland Blvd	California Blvd	3	3	2168	1312	1803	2780	2850	2850	0.76	0.46	0.63	0.98
			Cowell Road	North of Oak Grove Road	2	2	697	3193	3176	1004	1900	1900	0.37	**1.68**	**1.67**	0.53
			East of Civic Dr	Walnut Blvd	3	3	2048	2626	3431	1654	2850	2850	0.72	0.92	**1.20**	0.58
			Broadway	Main St	3	3	1677	1943	2106	1911	2700	2700	0.62	0.72	0.78	0.71
20	Imhoff Dr	East and West	Waterbird Way	Solano Way	2	2	150	353	280	151	1900	1900	0.08	0.19	0.15	0.08

No.	Name	Direc-tion	Cross Street 1	Cross Street 2	Lanes		AM Peak Volume (vph)		PM Peak Volume (vph)		Capacity (vph)		AM v/c		PM v/c	
					NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB
21	Clayton Road	East and West	5th St	Davis Avenue	2	2	416	2204	2145	757	1900	1900	0.22	**1.16**	**1.13**	0.40
			Ayers Road	Ygnacio Valley Rd	3	3	363	1641	1322	634	2700	2700	0.13	0.61	0.49	0.23
22	Evora Road	East and West	Willow Pass Rd	Driftwood Rd	1	1	169	1136	924	347	950	950	0.18	**1.20**	0.97	0.37
23	Loveridge Rd	North and South	California Ave	Pittsburg-Antioch Highway	2	2	609	852	824	809	1900	1900	0.32	0.45	0.43	0.43
			SR 4	Leland Road	2	2	1383	946	1364	1169	1900	1900	0.73	0.50	0.72	0.62
24	California Ave	East and West	Railroad Ave	Avon Street	1	1	149	545	323	633	800	800	0.19	0.68	0.40	0.79
			SR 4 (westbound ramp)	Carion Court	1	1	69	683	432	91	800	800	0.09	0.85	0.54	0.11

5.5. INTERSECTION ANALYSIS – 2015 BASELINE

All 53 intersections would operate with LOS D or better during both AM and PM peak hours except for the following locations:

- 2015 AM Peak Hour
  - **Intersection #51**: Ygnacio Valley Road and the Oak Grove Road would operate at LOS F. It currently operates with LOS E under existing conditions.
- 2015 PM Peak Hour
  - **Intersection #25:** SR 242 southbound On-Ramp/Commerce Avenue and Concord Avenue would operate at LOS F. It operates with LOS E under existing conditions.
  - **Intersection #53:** W Leland Road and Railroad Avenue would operate at LOS E. It operates at LOS C under existing conditions.

A summary table of the levels of service is presented in Exhibit 35 and Exhibit 36. Detailed Traffix LOS calculation sheets are included in Appendix D.

Exhibit 35: 2015 AM and PM Peak Hours Levels of Service Summary Table of Ramp Intersections

Location		Jurisdiction	2015 AM		2015 PM	
			LOS	V/C	LOS	V/C
1	SR 4 WB On-Ramp & Alhambra Ave	Martinez	C	0.72	C	0.72
2	SR 4 EB On-Ramp & Alhambra Ave	Martinez	B	0.65	A	0.57
3	SR 4 WB On-Ramp & Pine St	Martinez	A	0.46	A	0.49
4	SR 4 EB On-Ramp & Center Ave	Martinez	A	0.42	B	0.60
5	SR 4 WB On-Ramp & Morello Ave	Martinez	A	0.44	A	0.44
6	SR 4 EB On-Ramp & Morello Ave	Martinez	A	0.40	A	0.52
7	SR 4 WB On-Ramp & Pacheco Blvd	Martinez	A	0.47	B	0.61
8	SR 4 WB On-Ramp/Solano Way & Arnold Industrial Way/Imhoff Dr	Concord	A	0.47	B	0.63
9	SR 4 WB On-Ramp & Port Chicago Hwy	Concord	D	0.90	C	0.76
10	SR 4 WB On-Ramp & Willow Pass Rd	Bay Point	A	0.55	A	0.37
11	SR 4 EB On-Ramp & San Marco Blvd	Bay Point	A	0.41	B	0.66
12	SR 4 WB On-Ramp & Bailey Rd	Pittsburg	D	0.85	D	0.84
13	SR 4 EB On-Ramp & Bailey Rd	Pittsburg	A	0.43	C	0.78
14	SR 4 WB On-Ramp & Railroad Ave	Brentwood	B	0.61	B	0.64
15	SR 4 EB On-Ramp & Railroad Ave	Pittsburg	B	0.63	C	0.75
16	SR 4 WB On-Ramp & California Ave	Pittsburg	A	0.40	A	0.57
17	SR 4 EB On-Ramp & Loveridge Rd	Pittsburg	A	0.56	A	0.54
18	SR 4 WB On-Ramp & Somersville Rd	Antioch	A	0.41	A	0.53
19	SR 4 EB On-Ramp & Somersville Rd	Antioch	A	0.41	B	0.64
20	SR 4 WB On-Ramp & A St	Brentwood	A	0.43	A	0.56
21	SR 4 EB On-Ramp & Lone Tree Way	Antioch	A	0.33	A	0.54
22	SR 4 WB On-Ramp & Hillcrest Ave	Antioch	A	0.27	A	0.39
23	SR 4 EB On-Ramp & Hillcrest Ave	Antioch	A	0.43	A	0.56
24	SR 242 SB On-Ramp & Solano Way	Concord	B	0.64	A	0.51
25	SR 242 SB On-Ramp/Commerce Ave & Concord Ave	Concord	D	0.89	**F**	**1.01**
26	SR 242 NB On-Ramp/Market St & Concord Ave	Concord	A	0.54	B	0.68
27	SR 242 SB On-Ramp & Clayton Rd	Concord	C	0.71	C	0.72

Exhibit 36: 2015 AM and PM Peak Hours Levels of Service Summary Table of Intersections Away from Freeways

Location		Jurisdiction	2015 AM		2015 PM	
			LOS	V/C	LOS	V/C
28	Pacheco Blvd & Morello Ave	Martinez	B	0.62	B	0.68
29	Pacheco Blvd & Arthur Rd	Martinez	A	0.43	A	0.48
30	Contra Costa Blvd & Chilpancingo Parkway	Pleasant Hill	B	0.65	D	0.82
31	Concord Ave & Diamond Blvd	Concord	A	0.38	A	0.59
32	Contra Costa Blvd & Sunvalley Blvd/Willow Pass Rd	Pleasant Hill	A	0.48	C	0.71
33	I-680 NB On-Ramp & Willow Pass Rd	Concord	A	0.55	C	0.79
34	Diamond Blvd & Willow Pass Rd	Concord	A	0.37	B	0.61
35	Willow Pass Rd & Market St	Concord	A	0.53	B	0.62
36	Port Chicago Hwy & Olivera Rd	Concord	C	0.74	C	0.79
37	Port Chicago Hwy & Willow Pass Rd (South)	Concord	A	0.53	A	0.42
38	Willow Pass Rd & Galindo St	Concord	B	0.63	C	0.79
39	Port Chicago Hwy & Willow Pass Rd (North)	Bay Point	B	0.65	A	0.42
40	Willow Pass Rd & Bailey Rd	Bay Point	A	0.56	B	0.63
41	Bailey Rd & W Leland Rd	Bay Point	D	0.84	B	0.65
42	Tenth St & Railroad Ave	Pittsburg	A	0.44	A	0.47
43	Railroad Ave & Buchanan Rd	Pittsburg	C	0.72	A	0.56
44	Auto Center Dr & W 10th St	Antioch	A	0.59	B	0.66
45	Buchanan Rd & Somersville Rd	Antioch	D	0.84	B	0.67
46	Lone Tree Way & Ridgerock Dr/John Donlon Blvd	Antioch	D	0.87	C	0.78
47	E 18th St/Main St & Route 160 On-Ramp	Antioch	A	0.24	A	0.33
48	Bailey Rd & Concord Blvd	Concord	B	0.67	A	0.59
49	Clayton Rd & Treat Blvd	Concord	C	0.72	D	0.81
50	Ygnacio Valley Rd/Kirker Pass Rd & Clayton Rd	Concord	B	0.61	A	0.57
51	Ygnacio Valley Rd & Oak Grove Rd	Walnut Creek	**F**	**1.04**	D	0.88
52	California Ave & Loveridge Rd	Pittsburg	B	0.69	A	0.59
53	W Leland Road & Railroad Ave	Pittsburg	C	0.75	**E**	**0.92**

6. RAMP METERING PLAN

The 2015 baseline FREQ models for SR 4 and SR 242 were applied to develop draft metering rates for 2015 conditions. Based on information provided by Caltrans, ramp metering equipment along both corridors would be completely installed, repaired, or upgraded to current technology standards by 2015 and could all be operational by then.

A review of predicted Year 2015 congestion on SR 4 and SR 242 determined that:

- Ramp meters should be activated only in the westbound direction on SR 4 and the southbound direction on SR 242 during weekday AM peak periods (6 AM to 10 AM).
- Ramp meters should be activated only in the eastbound direction on SR 4 and in the northbound direction on SR 242 during weekday PM peak periods (3 PM to 7 PM).
- All meters should be set to serve the peak hour demand at each ramp unless the FREQ analysis indicated that a more optimal rate would result in improved performance for the system.

The following assumptions were made in the process of developing draft metering rates:

1. Ramp meters would operate with a policy of one car per green for all locations.
2. Preliminary rates were developed based on practical metering operation of 240 vehicles per hour per lane (vphpl) as a minimum limit, and 900 vphpl as a maximum limit.
3. Ramp meter rates are based on the FREQ corridor optimization module to maximize vehicle-miles of freeway travel with the constraint that queue lengths would be limited to available storage. On-ramp storage lengths are shown graphically on aerial photos attached in the Appendix E.
4. The ramp metering implementation plan would increase capacity at freeway bottleneck locations by approximately 2.5%. This is a conservative assumption based on capacity increases observed from other Bay Area freeway corridors where ramp meters were implemented.

Exhibit 37 provides a summary of the metering plan along both the SR 4 and SR 242 corridors, and Exhibit 38 provides a graphical illustration. It is suggested that optimal metering rates be implemented for on-ramps at and upstream of bottleneck and congested locations, and that demand rates be implemented downstream of bottleneck locations where the mainline would operate at more stable conditions. As shown in Exhibit 37, the metering plan recommends metering rates in the order of 93% to 100% of demands during each peak hour.

In summary, during the AM peak period in the westbound direction, optimal rates are suggested for on-ramps upstream of the Solano Way bottleneck in Concord. On-ramps west of Solano Way, as well as on-ramps along SR 242 southbound, would be metered at demand rates. During the PM peak period in the eastbound direction, optimal rates are suggested for on-ramps upstream of the Port Chicago Highway bottleneck, as well as on-ramps along SR 242 northbound, as they would feed traffic

into the bottleneck. For on-ramps east of the Port Chicago Highway, the downstream on-ramps would be metered at demand rates.

Note that freeway-to-freeway connectors, including the I-680 and SR 4 interchange and the SR 4 and SR 242 interchange, would not be metered as part of this plan.

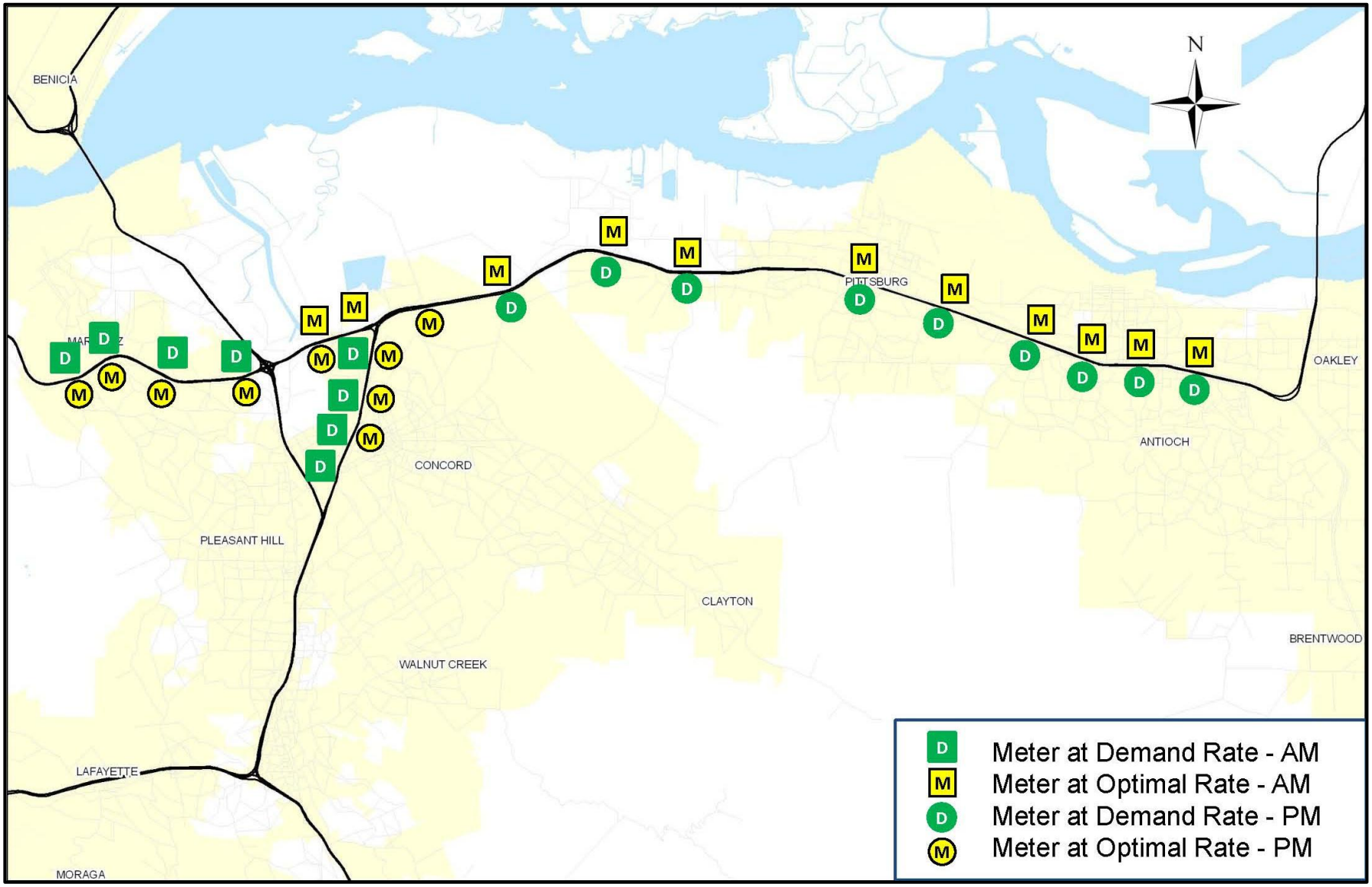
Exhibit 37: 2015 Ramp Metering Plan for SR 4 and SR 242

On-Ramp Location	2015 Metering Plan	Peak Hour RM Rate/ Demands Ratio
SR 4 Westbound AM		
Hillcrest Ave NB	Meter at FREQ suggested rates to improve operations	97%
Hillcrest Ave SB	Meter at FREQ suggested rates to improve operations	97%
Lone Tree Way/A St	Meter at FREQ suggested rates to improve operations	96%
L St/Contra Loma Blvd/G St	Meter at FREQ suggested rates to improve operations	96%
Somersville Rd / Auto Center Dr	Meter at FREQ suggested rates to improve operations	96%
Loveridge Rd	Meter at FREQ suggested rates to improve operations	98%
Railroad Ave	Meter at FREQ suggested rates to improve operations	97%
Bailey Road	Meter at FREQ suggested rates to improve operations	97%
San Marco Blvd/Willow Pass Rd NB Loop	Meter at FREQ suggested rates to improve operations	94%
San Marco Blvd/Willow Pass Rd Diag	Meter at FREQ suggested rates to improve operations	97%
Willow Pass Rd (West)	Meter at FREQ suggested rates to improve operations	97%
Port Chicago Hwy	Meter at FREQ suggested rates to improve operations	96%
Arnold Industrial Pl/Peralta Rd/ Solano Way	Meter at FREQ suggested rates to improve operations	96%
Pacheco Blvd/Muir Rd	Meter at demand rate	100%
Morello Ave	Meter at demand rate	100%
Pine St/Center Ave	Meter at demand rate	100%
Alhambra Ave	Meter at demand rate	100%
SR 4 Eastbound PM		
Alhambra Ave	Meter at FREQ suggested rates to improve operations	96%
Center Ave/Pine St	Meter at FREQ suggested rates to improve operations	95%
Morello Ave	Meter at FREQ suggested rates to improve operations	96%
Pacheco Blvd/Muir Rd	Meter at FREQ suggested rates to improve operations	98%
Solano Way/Arnold Industrial	Meter at FREQ suggested rates to improve operations	95%
Port Chicago Hwy	Meter at FREQ suggested rates to improve operations	93%
Willow Pass Rd	Meter at demand rate	100%
San Marco Blvd/Willow Pass Rd	Meter at demand rate	100%
San Marco Blvd/Willow Pass Rd	Meter at demand rate	100%
Bailey Road	Meter at demand rate	100%
Railroad Ave	Meter at demand rate	100%
Loveridge Rd	Meter at demand rate	100%
Somersville Rd	Meter at demand rate	100%
L St/Contra Loma Blvd/G St	Meter at demand rate	100%
Lone Tree Way/A Street	Meter at demand rate	100%
Hillcrest Ave	Meter at demand rate	100%

On-Ramp Location	2015 Metering Plan	Peak Hour RM Rate/ Demands Ratio
SR 242 Southbound AM		
Port Chicago Hwy	Meter at demand rate	100%
Olivera Rd WB	Meter at demand rate	100%
Olivera Rd EB	Meter at demand rate	100%
Solano Way	Meter at demand rate	100%
Concord Ave	Meter at demand rate	100%
Clayton Rd	Meter at demand rate	100%
SR 242 Northbound PM		
Concord Ave Loop	Meter at FREQ suggested rates to improve operations	94%
Concord Ave Diagonal	Meter at FREQ suggested rates to improve operations	96%
Solano Way	Meter at FREQ suggested rates to improve operations	96%

Note: demand ratio percentages apply to the peak hour demand. Shoulder hours are typically metered at higher, or faster rates.

Exhibit 38: Illustration of 2015 Ramp Metering Plan



6.1. DRAFT METERING RATES

This section presents draft metering rates developed for SR 4 and SR 242, as well as expected delays and queues at all metered on-ramps along both corridors. An iterative process of evaluations was performed to determine this set of draft metering rates using the FREQ model, in order to optimally balance ramp delays and queues, as well as mainline travel time savings. Details of this iterative process are included in Appendix F.

Exhibit 39 provides a summary of draft metering rates and expected ramp delays and queues for SR 4 on-ramps in the westbound direction during AM peak period. Available storage, as well as the number of on-ramp lanes leading up to the meter limit line, is shown in the exhibit. As shown in the exhibit, expected queues at each on-ramp due to the draft metering rates would be contained within available storage and would not affect arterial street operations. These draft metering rates are subject to further refinement prior to actual field implementation, based on new traffic counts to be collected.

Exhibit 39: Draft Ramp Metering Results for SR 4 WB On-Ramps – AM Peak Period

FREQ Origins/Locations	From	To	Hillcrest NB On	Hillcrest SB Ave	Lone Tree Way / A St	L St / Contra Loma Blvd / G St	Somersville Rd / Auto Center Dr	Loveridge Rd	Railroad Ave	Bailey Road	San Marco Blvd/Willow Pass Rd NB
Total Storage - Vehicles (lane feet)			38 (1140)	32 (960)	30 (900)	34 (1020)	44 (1320)	28 (840)	60 (1800)	50 (1500)	24 (740)
No. of MF Lanes at Limit Line			2	2	2	2	2	2	2	2	1
HOV bypass at Limit Line					1	1	1				
Time Slice	Ramp Metering Rate Per Lane Per Hour										
1	6:00 AM	7:00 AM	370	300	370	240	510	520	440	480	370
2	7:00 AM	8:00 AM	410	350	400	260	580	580	500	620	440
3	8:00 AM	9:00 AM	380	320	390	260	540	500	490	490	340
4	9:00 AM	10:00 AM	360	310	370	260	490	530	450	440	340
Time Slice	Ramp Queue Length in Vehicles per Time Slice										
1	6:00 AM	7:00 AM	24	20	30	21	39	17	27	31	22
2	7:00 AM	8:00 AM	10	18	18	10	24	13	27	14	3
3	8:00 AM	9:00 AM	10	5	14	14	23	20	33	21	12
4	9:00 AM	10:00 AM	0	19	6	3	10	10	10	11	9
Time Slice	Average Metering Delays (Minutes)										
1	6:00 AM	7:00 AM	0.9	1.0	1.2	1.3	1.1	0.5	0.9	0.9	1.7
2	7:00 AM	8:00 AM	1.3	1.6	1.8	1.8	1.6	0.8	1.6	1.1	1.8
3	8:00 AM	9:00 AM	0.8	1.1	1.2	1.4	1.3	1.0	1.8	1.1	1.3
4	9:00 AM	10:00 AM	0.4	1.1	0.8	1.0	1.0	0.9	1.5	1.1	1.9

FREQ Origins/Locations	From	To	San Marco Blvd / Willow Pass Rd Diag	Willow Pass Rd (West)	Port Chicago Hwy	Arnold Industrial Pl/Peralta Rd /Solano Way	Pacheco Blvd/Muir Rd	Morello Ave	Pine St / Center Ave	Alhambra Ave
Total Storage - Vehicles (lane feet)			61 (1845)	34 (1020)	189 (5670)	32 (960)	19 (590)	30 (900)	26 (780)	31 (940)
No. of MF Lanes at Limit Line			2	2	1	1	1	2	1	1
HOV bypass at Limit Line						1	1		1	
Time Slice	Ramp Metering Rate Per Lane Per Hour									
1	6:00 AM	7:00 AM	480	430	630	520	240	260	510	330
2	7:00 AM	8:00 AM	535	650	530	510	250	260	620	430
3	8:00 AM	9:00 AM	440	480	740	550	240	260	580	410
4	9:00 AM	10:00 AM	440	420	390	510	240	260	570	380
Time Slice	Ramp Queue Length in Vehicles per Time Slice									
1	6:00 AM	7:00 AM	31	21	0	0	0	0	0	0
2	7:00 AM	8:00 AM	18	28	23	22	0	0	0	0
3	8:00 AM	9:00 AM	17	27	10	4	0	0	0	0
4	9:00 AM	10:00 AM	7	24	0	0	0	0	0	0
Time Slice	Average Metering Delays (Minutes)									
1	6:00 AM	7:00 AM	0.9	0.7	0.0	0.0	0.0	0.0	0.0	0.0
2	7:00 AM	8:00 AM	1.4	1.1	1.2	1.2	0.0	0.0	0.0	0.0
3	8:00 AM	9:00 AM	1.2	1.7	1.4	1.5	0.0	0.0	0.0	0.0
4	9:00 AM	10:00 AM	0.8	1.8	0.8	0.2	0.0	0.0	0.0	0.0

Note: Grey cells indicate potential on-ramp queues and delays.

Note that the queues shown in this and subsequent exhibits are steady state at the end of the hour, which compares the total hourly flow rate versus hourly metering rate. Ramps with zero steady state queues at the end of the hour would have transient short queues within the hour, which would vary throughout the hour, when platoons of vehicles arrive from an upstream signal; however, the queues are expected to be of short duration (persisting for only a few signal cycles during the hour) and length. Monitoring of metering operation after initial activation would verify that the transient queues do not exceed the available storage. If they do, the metering rate could be adjusted accordingly.

Exhibit 40 provides a summary of draft metering rates and expected ramp delays and queues for SR 4 on-ramps in the eastbound direction during PM peak period. As shown in the exhibit, expected queues at each on-ramp due to the draft metering rates would be contained within available storage and would not affect arterial street operations.

Exhibit 40: Draft Ramp Metering Results for SR 4 EB On-Ramps – PM Peak Period

FREQ	From	To	Alhambra Ave	Center Ave/Pine St	Morello Ave	Pacheco Blvd/Muir Rd	Solano Way/Arnold Industrial	Port Chicago Hwy	Willow Pass Rd	San Marco Blvd / Willow Pass Rd
Origins/Locations										
Total Storage - Vehicles (lane feet)			31 (930)	64 (1920)	31 (930)	14 (420)	47 (1410)	123 (3690)	77 (2310)	44 (1320)
No. of MF Lanes at Limit Line			1	2	1	2	2	1	1	1
HOV bypass at Limit Line			1		1			1	1	
Time Slice	Ramp Metering Rate Per Lane Per Hour									
1	3:00 PM	4:00 PM	790	310	730	320	300	340	490	340
2	4:00 PM	5:00 PM	900	340	830	340	280	330	470	300
3	5:00 PM	6:00 PM	730	370	870	350	290	240	280	320
4	6:00 PM	7:00 PM	790	310	740	300	250	240	250	280
Time Slice	Ramp Queue Length in Vehicles per Time Slice									
1	3:00 PM	4:00 PM	21	8	20	1	0	1	0	0
2	4:00 PM	5:00 PM	25	31	24	10	27	24	0	0
3	5:00 PM	6:00 PM	22	23	27	14	26	0	0	0
4	6:00 PM	7:00 PM	31	26	28	8	17	0	0	0
Time Slice	Average Metering Delays (Minutes)									
1	3:00 PM	4:00 PM	0.7	0.4	0.8	0.1	0.0	0.1	0.0	0.0
2	4:00 PM	5:00 PM	1.3	1.7	1.6	0.5	1.4	2.1	0.0	0.0
3	5:00 PM	6:00 PM	1.6	2.1	1.7	1.0	2.6	0.5	0.0	0.0
4	6:00 PM	7:00 PM	1.7	2.3	2.2	1.1	2.5	0.0	0.0	0.0

FREQ	From	To	San Marco Blvd / Willow Pass Rd	Bailey Road	Railroad Ave	Loveridge Rd	Somersville Rd	L St/Contra Loma Blvd/G St overcrossing	Lone Tree Way/A Street	Hillcrest Ave
Origins/Locations										
Total Storage - Vehicles (lane feet)			39 (1170)	37 (1110)	22 (660)	38 (1140)	36 (1080)	17 (510)	19 (570)	28 (840)
No. of MF Lanes at Limit Line			1	1	1	2	2	1	1	2
HOV bypass at Limit Line				1	1	1	1	1	1	
Time Slice	Ramp Metering Rate Per Lane Per Hour									
1	3:00 PM	4:00 PM	240	810	610	500	330	280	360	240
2	4:00 PM	5:00 PM	240	760	600	530	350	350	440	240
3	5:00 PM	6:00 PM	240	700	520	540	360	370	460	240
4	6:00 PM	7:00 PM	240	640	450	430	310	360	400	240
Time Slice	Ramp Queue Length in Vehicles per Time Slice									
1	3:00 PM	4:00 PM	0	0	0	0	0	0	0	0
2	4:00 PM	5:00 PM	0	0	0	0	0	0	0	0
3	5:00 PM	6:00 PM	0	0	0	0	0	0	0	0
4	6:00 PM	7:00 PM	0	0	0	0	0	0	0	0
Time Slice	Average Metering Delays (Minutes)									
1	3:00 PM	4:00 PM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	4:00 PM	5:00 PM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	5:00 PM	6:00 PM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	6:00 PM	7:00 PM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Note: Grey cells indicate potential on-ramp queues and delays.

Exhibit 41 provides a summary of draft metering rates and expected ramp delays and queues for SR 242 on-ramps in the southbound direction during AM peak period. As shown in the exhibit, since on-ramps along this section of the corridor would be metered to serve demand volumes, there would be no expected sustained queue or delay at these on-ramps.

Exhibit 41: Draft Ramp Metering Results for SR 242 SB On-Ramps – AM Peak Period

FREQ Origins/Locations	From	To	Port Chicago Hwy	Olivera Rd Combined	Solano Way	Concord Ave	Clayton Rd
Total Storage - Vehicles (lane feet)			23 (690)	52 (1560)	16 (480)	24 (720)	60 (1800)
No. of MF Lanes at Limit Line			1	2	1	1	2
HOV bypass at Limit Line					1	1	
Time Slice	Ramp Metering Rate Per Lane Per Hour						
1	6:00 AM	7:00 AM	240	480	360	240	380
2	7:00 AM	8:00 AM	290	720	660	240	600
3	8:00 AM	9:00 AM	260	500	490	240	470
4	9:00 AM	10:00 AM	280	480	440	240	380
Time Slice	Ramp Queue Length in Vehicles per Time Slice						
1	6:00 AM	7:00 AM	0	0	0	0	0
2	7:00 AM	8:00 AM	0	0	0	0	0
3	8:00 AM	9:00 AM	0	0	0	0	0
4	9:00 AM	10:00 AM	0	0	0	0	0
Time Slice	Average Metering Delays (Minutes)						
1	6:00 AM	7:00 AM	0.0	0.0	0.0	0.0	0.0
2	7:00 AM	8:00 AM	0.0	0.0	0.0	0.0	0.0
3	8:00 AM	9:00 AM	0.0	0.0	0.0	0.0	0.0
4	9:00 AM	10:00 AM	0.0	0.0	0.0	0.0	0.0

Exhibit 42 provides a summary of draft metering rates and expected ramp delays and queues for SR 242 on-ramps in the northbound direction during PM peak period. As shown in the exhibit, expected queues at each on-ramp due to the draft metering rates would be contained within available storage and would not affect arterial street operations.

Exhibit 42: Draft Ramp Metering Results for SR 242 NB On-Ramps – PM Peak Period

FREQ Origins/Locations	From	To	Concord Ave Loop Ramp	Concord Ave Diagonal Ramp	Solano Way
Total Storage - Vehicles (lane feet)			45 (1350)	54 (1620)	22 (660)
No. of MF Lanes at Limit Line			1	2	1
HOV bypass at Limit Line			1	1	
Time Slice	Ramp Metering Rate Per Lane Per Hour				
1	3:00 PM	4:00 PM	670	500	420
2	4:00 PM	5:00 PM	640	530	380
3	5:00 PM	6:00 PM	620	540	400
4	6:00 PM	7:00 PM	500	500	310
Time Slice	Ramp Queue Length in Vehicles per Time Slice				
1	3:00 PM	4:00 PM	0	0	0
2	4:00 PM	5:00 PM	0	0	0
3	5:00 PM	6:00 PM	37	46	17
4	6:00 PM	7:00 PM	0	5	1
Time Slice	Average Metering Delays (Minutes)				
1	3:00 PM	4:00 PM	0.0	0.0	0.0
2	4:00 PM	5:00 PM	0.0	0.0	0.0
3	5:00 PM	6:00 PM	1.7	1.2	1.2
4	6:00 PM	7:00 PM	0.7	1.5	1.7

Note: Grey cells indicate potential on-ramp queues and delays.

6.2. FREEWAY OPERATIONS AND TRAVEL TIME COMPARISON

This section presents freeway mainline traffic operations and travel time comparisons on SR 4 and SR 242 with implementation of the draft ramp metering rates presented in the previous section.

Freeway Bottlenecks and Queues

Exhibit 43 provides a graphical comparison of expected mainline bottleneck locations, queue lengths, and congested speeds along SR 4 in 2015 for baseline condition and with ramp metering implementation. As shown in the exhibit, bottlenecks would develop at the same locations under baseline and with ramp metering conditions at Willow Pass Road (west) and Solano Way for the westbound direction in AM peak period and at I-680 and Port Chicago Highway for the eastbound direction in the PM peak period. However, corresponding queue lengths associated with each bottleneck would be reduced only in one out of four locations, as illustrated in Exhibit 43.

In the westbound direction during the AM peak period, SR 4 congested travel speeds approaching those bottleneck sections would increase from 29 mph to 31 mph approaching the Willow Pass Road (west) bottleneck following the implementation of ramp meters; congested travel speeds would increase from 15 mph to 18 mph approaching the Solano Way bottleneck.

In the eastbound direction during PM peak period, congested travel speeds approaching those bottleneck sections would increase from 18 mph to 24 mph approaching the I-680 bottleneck and would increase from 26 mph to 36 mph approaching the Port Chicago Highway bottleneck with ramp meters.

Exhibit 44 provides a graphical comparison of expected mainline bottleneck locations, queue lengths, and congested speeds along SR 242 in 2015 under baseline and with ramp metering conditions. In the northbound direction during the PM peak period, freeway queues on SR 4 would continue to cause congestion on northbound SR 242. However, mainline queues would be slightly shorter with ramp metering, as shown in the exhibit. In the southbound direction, the I-680 southbound mainline congestion would continue to cause congestion on southbound SR 242. However, increased freeway capacity on westbound SR 4 due to metering would allow additional traffic to reach SB SR 242 and congestion would increase slightly approaching SB I-680.

Congested travel speeds would be improved on SR 242 northbound direction from 46 mph to 50 mph and would be decreased in the southbound direction from 64 mph to 62 mph.

Exhibit 43: SR 4 Mainline Freeway Queues and Congested Speeds

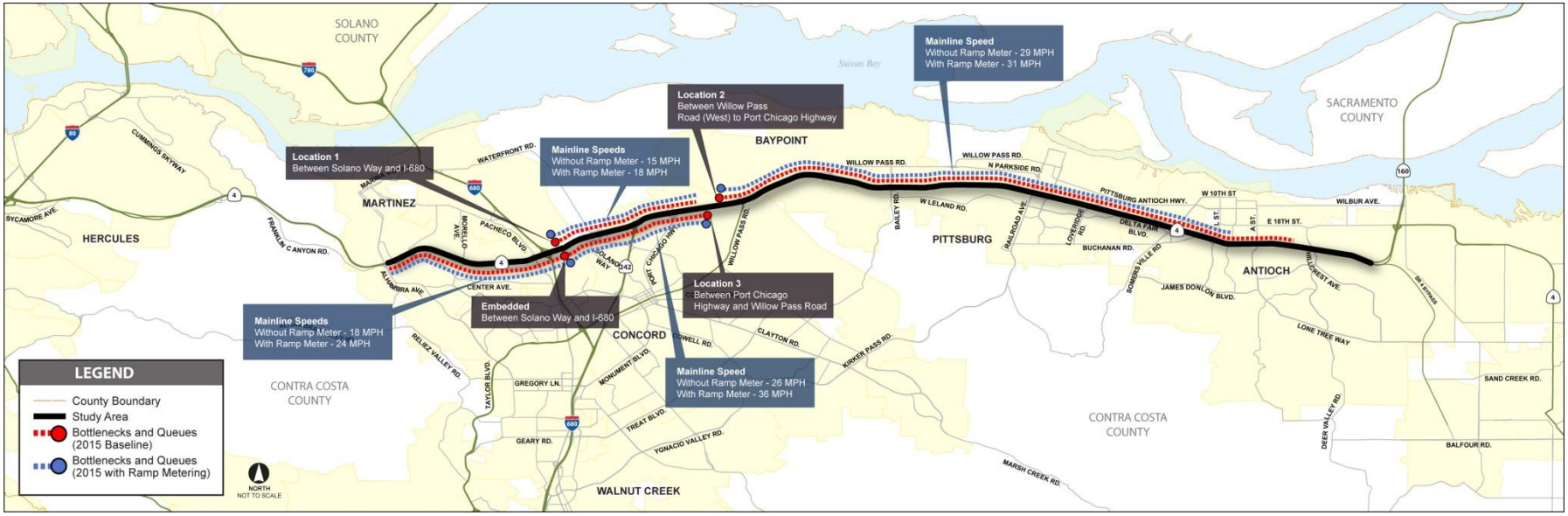
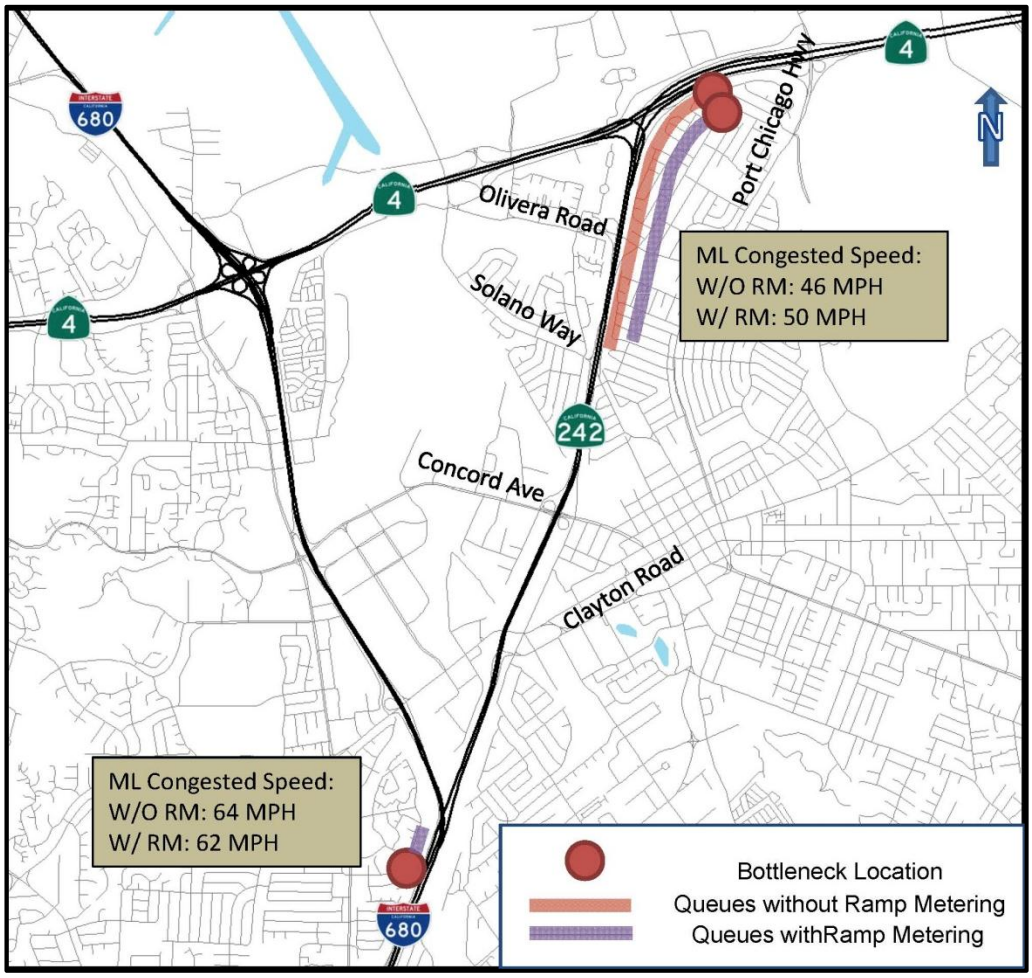


Exhibit 44: SR 242 Mainline Freeway Queues and Congested Speeds



Freeway Travel Time Comparison

Freeway travel time comparisons between 2015 baseline and with ramp metering conditions are provided in Exhibit 45 to Exhibit 48. As shown in Exhibit 45, travel times along SR 4 westbound from SR 160 to Alhambra Avenue during the AM peak period would experience an average reduction of 10 minutes, or approximately 16%. A reduction of as much as 13 minutes is expected during the peak hour of travel.

Exhibit 45: Travel Time Comparison on SR 4 WB during AM Peak Period

Start Time	End Time	2015 Baseline (no ramp metering) (minutes)	2015 With Ramp Metering (minutes)	Difference	
				(minutes)	(%)
6:00 AM	7:00 AM	26.9	24.6	-2.4	-9%
7:00 AM	8:00 AM	59.7	48.3	-11.4	-19%
8:00 AM	9:00 AM	83.4	70.2	-13.2	-16%
9:00 AM	10:00 AM	79.6	66.7	-12.9	-16%
Average		**62.4**	**52.4**	**-10.0**	**-16%**

Note: Mainline travel times are between SR 160 and Alhambra Avenue, or approximately 21 miles.

Exhibit 46 shows corridor travel time for SR 4 westbound and SR 242 southbound combined, starting from SR 160 on the east through SR 242 southbound to I-680 southbound. As shown in the exhibit, this corridor would experience an average travel time reduction of over 9 minutes, or approximately 16%. A reduction of nearly 13 minutes is expected during the peak hour of travel from SR 160 to I-680.

Exhibit 46: Travel Time Comparison from SR 4 WB to SR 242 SB During AM Peak Period

Start Time	End Time	2015 Baseline (no ramp metering) (minutes)	2015 With Ramp Metering (minutes)	Difference	
				(minutes)	(%)
6:00 AM	7:00 AM	23.7	21.6	-2.1	-9%
7:00 AM	8:00 AM	53.6	43.3	-10.3	-19%
8:00 AM	9:00 AM	77.0	64.2	-12.7	-17%
9:00 AM	10:00 AM	73.6	61.7	-11.9	-16%
Average		**56.9**	**47.7**	**-9.3**	**-16%**

Note: Mainline travel times are between SR 4 at SR 160 to SR 242 at I-680, or approximately 19 miles.

As shown in Exhibit 47, travel times along SR 4 eastbound from Alhambra Avenue to SR 160 during the PM peak period would experience an average reduction of over 7 minutes, or approximately 19%, and as much as 16 minutes during the peak hour of travel.

Exhibit 47: Travel Time Comparison on SR 4 EB During PM Peak Period

Start Time	End Time	2015 Baseline (no ramp metering) (minutes)	2015 With Ramp Metering (minutes)	Difference	
				(minutes)	(%)
3:00 PM	4:00 PM	23.6	22.5	-1.1	-5%
4:00 PM	5:00 PM	28.6	24.9	-3.6	-13%
5:00 PM	6:00 PM	42.4	33.5	-9.0	-21%
6:00 PM	7:00 PM	57.9	41.9	-16.0	-28%
Average		**38.1**	**30.7**	**-7.4**	**-19%**

Note: Mainline travel times are between Alhambra Avenue and SR 160, or approximately 21 miles.

Exhibit 48 shows corridor travel time for SR 242 northbound and SR 4 eastbound combined, starting from I-680 in the south, continuing on SR 4 eastbound to SR 160. As shown in the exhibit, this corridor would experience an average reduction of about one minute, or approximately 5%. Travel time savings shown on this table is generally less compared to the previous exhibits above because there would be congestion on SR 4 eastbound east of Port Chicago Highway.

Exhibit 48: Travel Time Comparison from SR 242 NB to SR 4 EB during PM Peak Period

Start Time	End Time	2015 Baseline (no ramp metering) (minutes)	2015 With Ramp Metering (minutes)	Difference	
				(minutes)	(%)
3:00 PM	4:00 PM	19.3	18.5	-0.8	-4%
4:00 PM	5:00 PM	20.6	18.9	-1.7	-8%
5:00 PM	6:00 PM	23.0	21.4	-1.7	-7%
6:00 PM	7:00 PM	24.3	23.7	-0.5	-2%
Average		**21.8**	**20.6**	**-1.2**	**-5%**

Note: Mainline travel times are between SR 242 at I-680 and SR 4 at SR 160, or approximately 19 miles.

6.3. FREEWAY SYSTEM PERFORMANCE MEASURES

Exhibit 49 and Exhibit 50 provide a summary of freeway system-wide performance measures over the entire peak period from 6 AM to 10 AM in the morning and from 3 PM to 7 PM in the afternoon. System performance measures include both freeway mainline, as well as on-ramps and off-ramps along both SR 4 and SR 242 corridors within the study limits.

As shown in Exhibit 49, freeway mainline vehicle hours of travel would be reduced by as much as 10% during the AM peak period, which translates to reductions in freeway vehicle hours of delay. System productivity would increase by 2% as shown in the vehicle miles of travel. Average travel speed would increase by 13%.

Exhibit 50 shows that during the PM peak period, freeway mainline vehicle hours of travel would reduce by as much as 11%, which translates to reductions in freeway vehicle hours of delay. System productivity would increase by 2% as shown in the vehicle miles of travel. Average travel speed would increase by 14%.

Exhibit 49: Freeway System Performance Measures – AM 4 Hour Peak Period

Performance Measure	VHT (mainline)	VHT (System)	VMT (System)	Avg. Speed (mph)
With Ramp Metering	18,304	19,162	511,687	28
Without Ramp Metering	20,334	20,347	501,276	25
Difference	-2,030	-1,185	10,411	3
% Difference	-10%	-6%	2%	13%

Note: Freeway system includes both SR 4 and SR 242, mainline segments and ramps.

Exhibit 50: Freeway System Performance Measures – PM 4 Hour Peak Period

Performance Measure	VHT (mainline)	VHT (System)	VMT (System)	Avg. Speed (mph)
With Ramp Metering	11,768	12,570	548,734	47
Without Ramp Metering	13,199	13,573	540,555	41
Difference	-1,431	-1,003	8,179	6
% Difference	-11%	-7%	2%	14%

Note: Freeway system includes both SR 4 and SR 242, mainline segments and ramps.

7. RAMP METERING EFFECTS ON OTHER FREEWAYS, ARTERIALS AND INTERSECTIONS

In order to evaluate potential ramp metering effects on local streets and other freeway segments within the study vicinity in Contra Costa, the CCTA model was applied to evaluate the amount of potential traffic diversions. Draft metering rates were coded into the CCTA model at corresponding on-ramps along both SR 4 and SR 242, and traffic assignment was re-run to evaluate differences on link and turning volumes.

7.1. OTHER FREEWAYS

Exhibit 51 to Exhibit 54 provide comparisons of adjacent freeway segment v/c ratios between 2015 baseline and with ramp metering conditions, as well as comparisons of congested speeds through those facilities. These include sections of I-680, SR 160, and SR 4 east of SR 160. As shown in the exhibits, implementation of the ramp metering plan would result in minor traffic diversion traffic at these facilities. The maximum peak hour volume difference is 35 vph (less than 1% of the peak hour volume) on I-680 northbound between Concord Avenue and SR 4 during the PM peak hour, which would translate into a 0.5 mph decrease in congested speed on this segment.

Exhibit 51. Other Adjacent Freeway Segments – AM Peak Hour Volume Comparison

Freeway	From	To	Lanes		2015 AM Peak Hour Volume (vph)						2015 AM Peak Hour (Volume / Capacity)					
					Baseline		w/Ramp Metering		Difference		Baseline		w/Ramp Metering		Difference	
			NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB
I-680	Pacheco Blvd	Arthur Road	3	3	4416	4996	4414	4998	-2	1	0.75	0.85	0.75	0.85	0.00	0.00
	North of Willow Pass Road	South of Concord Ave	4	4	4750	6141	4746	6135	-4	-5	0.63	0.81	0.62	0.81	0.00	0.00
	Pacheco Blvd	SR 4	3	3	4895	5313	4876	5311	-19	-2	0.86	0.93	0.86	0.93	0.00	0.00
	North of Concord Ave	SR 4	3	3	4941	5101	4941	5089	0	-13	0.84	0.87	0.84	0.87	0.00	0.00
	SR-242	South of Willow Pass Road	3	3	4984	4830	4983	4829	-1	-1	0.87	0.85	0.87	0.85	0.00	0.00
SR 160	Foot of Bridgehead Road	South of Wilbur Ave	2	2	481	402	481	402	0	0	0.12	0.10	0.12	0.10	0.00	0.00
	North of 18th Street	North of Oakley Road	2	2	813	612	814	613	0	1	0.21	0.16	0.21	0.16	0.00	0.00
SR 4 E/O SR 160	Lone Tree Parkway	Laurel Road	2	2	3339	1142	3341	1142	1	0	0.83	0.29	0.84	0.29	0.00	0.00

Note: "-" difference indicates a decrease with ramp metering conditions.

Exhibit 52. Other Adjacent Freeway Segments – AM Peak Hour Congested Speed and Travel Time Comparison

Freeway	From	To	2015 AM Congested Speed (mph)						2015 AM Congested Travel time (min)						Length (mile)	
			Baseline		w/Ramp Metering		Difference		Baseline		w/Ramp Metering		Difference			
			NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB
I-680	Pacheco Blvd	Arthur Road	53.6	45.5	53.6	45.5	0.0	0.0	0.8	0.8	0.8	0.8	0.0	0.0	0.70	0.61
	North of Willow Pass Road	South of Concord Ave	56.8	45.6	56.8	45.6	0.0	0.1	0.3	0.5	0.3	0.5	0.0	0.0	0.32	0.36
	Pacheco Blvd	SR 4	44.8	37.6	45.1	37.6	0.3	0.0	1.0	1.4	1.0	1.4	0.0	0.0	0.73	0.85
	North of Concord Ave	SR 4	42.8	40.2	42.8	40.4	0.0	0.2	1.3	1.2	1.3	1.2	0.0	0.0	0.93	0.80
	SR-242	South of Willow Pass Road	39.8	41.9	39.9	41.9	0.0	0.0	0.7	0.3	0.7	0.3	0.0	0.0	0.44	0.19
SR 160	Foot of Bridgehead Road	South of Wilbur Ave	60.2	59.6	60.2	59.6	0.0	0.0	0.3	0.5	0.3	0.5	0.0	0.0	0.35	0.45
	North of 18th Street	North of Oakley Road	59.9	59.6	59.9	59.6	0.0	0.0	0.6	0.5	0.6	0.5	0.0	0.0	0.56	0.54
SR 4 E/O SR 160	Lone Tree Parkway	Laurel Road	47.1	64.9	47.0	64.9	0.0	0.0	1.1	0.8	1.1	0.8	0.0	0.0	0.90	0.86

Note: "-" difference indicates a decrease with ramp metering conditions.

Exhibit 53. Other Adjacent Freeway Segments – PM Peak Hour Volume Comparison

Freeway	From	To	Lanes		2015 PM Peak Hour Volume (vph)						2015 PM Peak Hour (Volume / Capacity)					
					Baseline		w/Ramp Metering		Difference		Baseline		w/Ramp Metering		Difference	
			NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB
I-680	Pacheco Blvd	Arthur Road	3	3	4527	4534	4527	4534	0	0	0.77	0.78	0.77	0.78	0.00	0.00
	North of Willow Pass Road	South of Concord Ave	4	4	5506	5537	5514	5549	8	12	0.72	0.73	0.73	0.73	0.00	0.00
	Pacheco Blvd	SR 4	3	3	4938	4997	4935	5005	-3	8	0.87	0.88	0.87	0.88	0.00	0.00
	North of Concord Ave	SR 4	3	3	5013	5385	5048	5374	35	-11	0.86	0.92	0.86	0.92	0.01	0.00
	SR-242	South of Willow Pass Road	3	3	4778	5706	4772	5708	-6	2	0.84	1.00	0.84	1.00	0.00	0.00
SR 160	Foot of Bridgehead Road	South of Wilbur Ave	2	2	493	536	492	536	0	0	0.13	0.14	0.13	0.14	0.00	0.00
	North of 18th Street	North of Oakley Road	2	2	603	781	602	782	-1	1	0.15	0.20	0.15	0.20	0.00	0.00
SR 4 E/O SR 160	Lone Tree Parkway	Laurel Road	2	2	3259	1608	3260	1605	1	-3	0.81	0.40	0.82	0.40	0.00	0.00

Note: "-" difference indicates a decrease with ramp metering conditions.

Exhibit 54. Other Adjacent Freeway Segments – PM Peak Hour Congested Speed and Travel Time Comparison

Freeway	From	To	2015 PM Congested Speed (mph)						2015 PM Congested Travel time (min)						Length (mile)	
			Baseline		w/Ramp Metering		Difference		Baseline		w/Ramp Metering		Difference			
			NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB
I-680	Pacheco Blvd	Arthur Road	52.1	52.6	52.1	52.6	0.0	0.0	0.8	0.7	0.8	0.7	0.0	0.0	0.70	0.61
	North of Willow Pass Road	South of Concord Ave	52.1	51.2	52.0	51.1	-0.1	-0.1	0.4	0.4	0.4	0.4	0.0	0.0	0.32	0.36
	Pacheco Blvd	SR 4	44.1	43.2	44.1	43.0	0.0	-0.1	1.0	1.2	1.0	1.2	0.0	0.0	0.73	0.85
	North of Concord Ave	SR 4	41.8	35.7	41.2	35.9	-0.5	0.2	1.3	1.3	1.4	1.3	0.0	0.0	0.93	0.80
	SR-242	South of Willow Pass Road	43.1	27.9	43.2	27.8	0.1	0.0	0.6	0.4	0.6	0.4	0.0	0.0	0.44	0.19
SR 160	Foot of Bridgehead Road	South of Wilbur Ave	60.2	59.6	60.2	59.6	0.0	0.0	0.3	0.5	0.3	0.5	0.0	0.0	0.35	0.45
	North of 18th Street	North of Oakley Road	59.9	59.6	59.9	59.6	0.0	0.0	0.6	0.5	0.6	0.5	0.0	0.0	0.56	0.54
SR 4 E/O SR 160	Lone Tree Parkway	Laurel Road	48.9	64.7	48.9	64.7	0.0	0.0	1.1	0.8	1.1	0.8	0.0	0.0	0.90	0.86

Note: "-" difference indicates a decrease with ramp metering conditions.

7.2. ARTERIALS

Exhibit 55 to Exhibit 58 provide comparisons of arterial segment v/c ratios between 2015 baseline and with ramp metering conditions. Arterial segments with v/c ratio higher than 1.0 are highlighted. As shown in the exhibits, implementation of the ramp metering plan would result in minor changes to traffic volumes at these facilities. The maximum peak hour volume increase on any key arterial segment would be about 37 vph during the AM peak hour (about 5% of total segment volume or about 0.05 increase in v/c ratio) and about 24 vph during the PM peak hour (about 1% of total segment volume or less than 0.01 increase in v/c ratio). As shown in the exhibits, a number of arterials would experience a decrease in peak hour traffic volume due to the re-routing of traffic.

Exhibit 55: Arterial Segments – AM Peak Hour Volume Comparison

No.	Name	Direction	Cross Street 1	Cross Street 2	Lanes		2015 AM Peak Volume (vph)						2015 AM Peak Hour (Volume / Capacity)					
							Baseline		With Ramp Metering		Difference		Baseline		With Ramp Metering		Difference	
					NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB
1	10th St	E-W	H St	G St	1	1	91	1074	91	1059	0	-15	0.10	**1.13**	0.10	**1.11**	0.00	-0.02
		E-W	L St	K St	1	1	117	1107	116	1092	-1	-15	0.12	**1.17**	0.12	**1.15**	0.00	-0.02
		E-W	K St	H St	1	1	86	1051	86	1036	0	-15	0.10	**1.17**	0.10	**1.15**	0.00	-0.02
2	18th St	E-W	A St	Alpha Way	1	1	150	1042	150	1069	0	27	0.16	**1.10**	0.16	**1.13**	0.00	0.03
		E-W	Alpha Way	Crestwood Dr	1	1	173	1037	173	1064	0	27	0.18	**1.09**	0.18	**1.12**	0.00	0.03
		E-W	Crestwood Dr	Cavallo Road	1	1	214	1137	214	1164	0	27	0.23	**1.20**	0.23	**1.23**	0.00	0.03
3	9th St	E-W	C St	D St	1	1	26	158	26	158	0	0	0.04	0.23	0.04	0.23	0.00	0.00
		E-W	A St	C St	1	1	38	203	38	203	0	0	0.05	0.29	0.05	0.29	0.00	0.00
4	Alhambra Ave	N-S	Alhambra Valley Road	Kim Ct	1	1	557	696	568	693	12	-3	0.59	0.73	0.60	0.73	0.01	0.00
		N-S	North of SR 4	North of Walnut Ave	2	2	1734	1260	1720	1252	-14	-9	0.96	0.70	0.96	0.70	-0.01	0.00
		N-S	Franklin Canyon Road	South of SR 4	1	1	555	677	567	674	12	-3	0.58	0.71	0.60	0.71	0.01	0.00
5	Bailey Rd	N-S	Leland Rd	Maylard St	2	3	1710	713	1698	708	-12	-5	0.95	0.26	0.94	0.26	-0.01	0.00
		N-S	Willow Pass Road	Placer Dr	2	2	611	667	612	669	1	2	0.32	0.35	0.32	0.35	0.00	0.00
		N-S	North of Maylard St	S. of SR 4 (S. of On-ramp)	2	3	1567	1543	1555	1538	-12	-5	0.87	0.57	0.86	0.57	-0.01	0.00
		N-S	North of SR 4	Canal Road	2	2	1909	977	1892	976	-17	-1	1.00	0.51	1.00	0.51	-0.01	0.00
6	Buchanan Rd	E-W	Railroad Ave	West of Book Side Dr	1	1	450	1319	456	1320	6	1	0.47	**1.39**	0.48	**1.39**	0.01	0.00
		E-W	Somersville Road	West of Gentrytown Dr	2	2	261	867	261	876	0	9	0.14	0.46	0.14	0.46	0.00	0.00
		E-W	Del Oro Cir	Contra Loma Blvd	2	2	85	1416	85	1397	1	-19	0.04	0.75	0.04	0.74	0.00	-0.01
		E-W	East of Meadows Ave	Somersville Road	1	1	522	1431	528	1430	6	0	0.55	**1.51**	0.56	**1.51**	0.01	0.00
		E-W	Loveridge Road	Mcfaul Dr	1	1	479	977	485	977	6	1	0.50	**1.03**	0.51	**1.03**	0.01	0.00
		E-W	East of Railroad Ave	Brookside Dr	1	1	317	1018	322	1019	6	1	0.33	**1.07**	0.34	**1.07**	0.01	0.00
7	Contra Costa Blvd	N-S	Chilpancingo Pkwy	North of Golf Club Rd	2	2	552	933	544	892	-8	-41	0.29	0.49	0.29	0.47	0.00	-0.02
		N-S	North of Hookston Rd	Boyd Rd	2	2	612	1750	613	1751	1	1	0.32	0.92	0.32	0.92	0.00	0.00
		N-S	Harriet Dr	Taylor Blvd	2	2	737	1178	740	1181	2	3	0.38	0.60	0.38	0.60	0.00	0.00
		N-S	2nd Ave	Center Ave	2	2	645	2127	644	2153	-1	26	0.33	1.09	0.33	1.10	0.00	0.01
		N-S	Oak Park Blvd	North of Oakpark Blvd	2	2	305	1570	305	1567	0	-3	0.16	0.83	0.16	0.82	0.00	0.00
8	E 18th St	E-W	West of SR 160	Phillips Ln	1	1	179	383	184	384	5	1	0.19	0.40	0.19	0.40	0.01	0.00
		E-W	Cavallo Road	Biglow Dr.	1	1	203	1117	203	1145	0	28	0.21	**1.18**	0.21	**1.21**	0.00	0.03
		E-W	Vineyard Dr	Willow Ave	1	1	151	597	151	594	0	-2	0.16	0.63	0.16	0.63	0.00	0.00
9	Hillcrest Ave	N-S	Interchange (North of SR 4)	SR 4	3	3	2004	471	1990	477	-14	6	0.74	0.17	0.74	0.18	-0.01	0.00
		N-S	South of Larkspur Dr	North of Davison Dr	3	3	2384	973	2375	979	-10	6	0.88	0.36	0.88	0.36	0.00	0.00
10	James Donlon Blvd	E-W	Contra Loma Blvd	Blythe Dr	2	2	152	816	152	816	0	0	0.08	0.43	0.08	0.43	0.00	0.00
		E-W	S Royal Links Cir	Lone Tree Way	2	2	496	1018	494	1018	-2	0	0.26	0.54	0.26	0.54	0.00	0.00

No.	Name	Direction	Cross Street 1	Cross Street 2	Lanes		2015 AM Peak Volume (vph)						2015 AM Peak Hour (Volume / Capacity)					
							Baseline		With Ramp Metering		Difference		Baseline		With Ramp Metering		Difference	
					NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB
11	Kirker Pass Rd	N-S	Concord Blvd	Kirkwood Dr	3	3	675	2435	674	2441	0	6	0.24	0.85	0.24	0.86	0.00	0.00
		N-S	Nortonville Rd	North of Hess Rd	2	2	560	2019	559	2025	0	6	0.29	**1.06**	0.29	**1.07**	0.00	0.00
		N-S	Castlewood Dr	Pheasant Dr	2	2	750	1997	749	2001	-1	5	0.42	**1.11**	0.42	**1.11**	0.00	0.00
12	Leland Rd	E-W	Railroad Ave	West of Presidio Ln	2	2	605	1264	609	1287	4	23	0.32	0.67	0.32	0.68	0.00	0.01
		E-W	Crestview Dr	Railroad Ave	2	2	662	1113	660	1117	-2	3	0.35	0.59	0.35	0.59	0.00	0.00
		E-W	John Johnson Pkwy	West of Golf Club Rd	2	2	304	1492	303	1489	0	-3	0.16	0.79	0.16	0.78	0.00	0.00
		E-W	Willow Ave	Bailey Rd	2	2	323	1877	323	1874	0	-3	0.17	0.99	0.17	0.99	0.00	0.00
13	Lone Tree Wy	N-S	Worrell Rd	Hillside Rd	2	2	1648	402	1624	396	-24	-6	0.87	0.21	0.85	0.21	-0.01	0.00
		N-S	South of Clearbrook Rd	Davison Dr	2	2	1564	350	1546	350	-19	0	0.87	0.19	0.86	0.19	-0.01	0.00
14	Pacheco Blvd	N-S	Blum Road	South of Arnold Dr	1	1	678	1000	715	1005	37	5	0.75	**1.11**	0.79	**1.12**	0.04	0.01
		N-S	Muir Rd	Buchanan Cir	2	2	441	599	439	626	-2	27	0.23	0.32	0.23	0.33	0.00	0.01
		N-S	1st Ave	Center Ave	2	2	581	1569	579	1595	-2	27	0.31	0.83	0.30	0.84	0.00	0.01
15	Pittsburg-Antioch Hwy	E-W	Verne Roberts Cir	Auto Center Dr	1	1	1126	479	1126	500	0	21	**1.19**	0.50	**1.19**	0.53	0.00	0.02
		E-W	Loveridge Road	Columbia St	1	1	258	983	258	993	0	9	0.27	**1.04**	0.27	**1.05**	0.00	0.01
		E-W	Loveridge Road	California Ave	1	1	217	1620	217	1641	0	21	0.23	**1.71**	0.23	**1.73**	0.00	0.02
16	Somersville Rd	N-S	Century Blvd	Sycamore Dr	3	3	733	851	734	860	1	9	0.27	0.32	0.27	0.32	0.00	0.00
		N-S	Delta Fair Blvd	Fairview Dr	2	2	538	149	540	139	2	-10	0.30	0.08	0.30	0.08	0.00	-0.01
17	Treat Blvd	E-W	I-680	Oak Rd	3	3	1282	2192	1283	2201	1	9	0.45	0.77	0.45	0.77	0.00	0.00
		E-W	East of Oak Grove Rd	Blarney Ave	3	3	285	2373	285	2382	0	9	0.10	0.83	0.10	0.84	0.00	0.00
		E-W	Sheppard Rd	Cherry Ln	3	3	1926	3515	1926	3516	0	1	0.66	**1.20**	0.66	**1.20**	0.00	0.00
		E-W	Arkell Rd	Winton Dr	3	3	553	2459	552	2470	-1	11	0.19	0.86	0.19	0.87	0.00	0.00
18	Willow Pass Rd	N-S	SR-4	Avila Road	1	1	821	1025	820	1024	-1	-1	0.86	**1.08**	0.86	**1.08**	0.00	0.00
		N-S	Port Chicago Highway	West of Parkside Dr	2	2	505	990	491	973	-14	-17	0.28	0.55	0.27	0.54	-0.01	-0.01
		N-S	I-680	Diamond Blvd	3	3	1747	1357	1754	1363	7	6	0.65	0.50	0.65	0.50	0.00	0.00
		N-S	Market St	Fry Way	3	3	913	1299	899	1304	-14	5	0.32	0.46	0.32	0.46	0.00	0.00
		N-S	Mt. Diablo St	Concord Ave	2	2	577	1154	563	1159	-15	6	0.32	0.64	0.31	0.64	-0.01	0.00
19	Ygnacio Valley Rd	N-S	Walnut Ave	Wimbledon Rd	3	3	835	952	834	952	-1	0	0.29	0.33	0.29	0.33	0.00	0.00
		N-S	Oakland Blvd	California Blvd	3	3	2168	1312	2168	1305	1	-6	0.76	0.46	0.76	0.46	0.00	0.00
		N-S	Cowell Road	North of Oak Grove Road	2	2	697	3193	698	3196	0	2	0.37	**1.68**	0.37	**1.68**	0.00	0.00
		N-S	East of Civic Dr	Walnut Blvd	3	3	2048	2626	2044	2626	-3	0	0.72	0.92	0.72	0.92	0.00	0.00
		N-S	Broadway	Main St	3	3	1677	1943	1674	1944	-3	1	0.62	0.72	0.62	0.72	0.00	0.00
20	Imhoff Dr	E-W	Waterbird Way	Solano Way	2	2	150	353	149	350	-1	-3	0.08	0.19	0.08	0.18	0.00	0.00
21	Clayton Road	E-W	5th St	Davis Avenue	2	2	416	2204	416	2198	0	-5	0.22	**1.16**	0.22	**1.16**	0.00	0.00
		E-W	Ayers Road	Ygnacio Valley Rd	3	3	363	1641	363	1644	-1	4	0.13	0.61	0.13	0.61	0.00	0.00
22	Evora Road	E-W	Willow Pass Rd	Driftwood Rd	1	1	169	1136	169	1149	0	13	0.18	**1.20**	0.18	**1.21**	0.00	0.01

No.	Name	Direction	Cross Street 1	Cross Street 2	Lanes		2015 AM Peak Volume (vph)						2015 AM Peak Hour (Volume / Capacity)					
							Baseline		With Ramp Metering		Difference		Baseline		With Ramp Metering		Difference	
					NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB
23	Loveridge Rd	N-S	California Ave	Pittsburg-Antioch Highway	2	2	609	852	616	870	7	18	0.32	0.45	0.32	0.46	0.00	0.01
		N-S	SR-4	Leland Road	2	2	1383	946	1371	946	-12	1	0.73	0.50	0.72	0.50	-0.01	0.00
24	California Ave	E-W	Railroad Ave	Avon Street	1	1	149	545	148	557	-2	12	0.19	0.68	0.18	0.70	0.00	0.01
		E-W	SR-4 (westbound ramp)	Carion Court	1	1	69	683	53	683	-16	0	0.09	0.85	0.07	0.85	-0.02	0.00

Note: "-" difference indicates a decrease with ramp metering conditions.

Exhibit 56: Arterial Segments – AM Peak Hour Congested Speed and Travel Time Comparison

No.	Name	Direction	Cross Street 1	Cross Street 2	2015 AM Congested Speed (mph)						2015 AM Travel Time (min.)						Length (mile)
					Baseline		With Ramp Metering		Difference		Baseline		With Ramp Metering		Difference		
					NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	
1	10th St	E-W	H St	G St	34.9	10.3	34.9	11.2	0.0	0.9	0.1	0.4	0.1	0.4	0.0	0.0	0.07
		E-W	L St	K St	34.9	8.8	34.9	9.4	0.0	0.6	0.1	0.5	0.1	0.4	0.0	0.0	0.07
		E-W	K St	H St	30.0	8.3	30.0	8.9	0.0	0.6	0.4	1.4	0.4	1.3	0.0	-0.1	0.19
2	18th St	E-W	A St	Alpha Way	34.9	12.3	34.9	10.5	0.0	-1.7	0.5	1.4	0.5	1.7	0.0	0.2	0.29
		E-W	Alpha Way	Crestwood Dr	34.9	12.7	34.9	10.8	0.0	-1.8	0.1	0.4	0.1	0.4	0.0	0.1	0.08
		E-W	Crestwood Dr	Cavallo Road	34.9	7.7	34.9	7.0	0.0	-0.7	0.2	1.1	0.2	1.2	0.0	0.1	0.14
3	9th St	E-W	C St	D St	35.0	34.8	35.0	34.8	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.07
		E-W	A St	C St	35.0	34.7	35.0	34.7	0.0	0.0	0.3	0.3	0.3	0.3	0.0	0.0	0.15
4	Alhambra Ave	N-S	Alhambra Valley Road	Kim Ct	39.1	38.2	39.0	38.3	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.07
		N-S	North of SR 4	North of Walnut Ave	26.3	29.5	26.8	29.6	0.4	0.0	0.2	0.2	0.2	0.2	0.0	0.0	0.10
		N-S	Franklin Canyon Road	South of SR 4	34.3	33.8	34.3	33.8	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.04
5	Bailey Rd	N-S	Leland Rd	Maylard St	27.0	30.0	27.3	30.0	0.3	0.0	0.2	0.2	0.2	0.2	0.0	0.0	0.09
		N-S	Willow Pass Road	Placer Dr	34.9	34.9	34.9	34.9	0.0	0.0	0.3	0.3	0.3	0.3	0.0	0.0	0.16
		N-S	North of Maylard St	S. of SR 4 (S. of On-ramp)	28.7	29.8	28.8	29.8	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.01
		N-S	North of SR 4	Canal Road	24.9	34.7	26.5	34.7	1.6	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.06
6	Buchanan Rd	E-W	Railroad Ave	West of Book Side Dr	34.5	4.5	34.5	4.5	0.0	0.0	0.2	1.2	0.2	1.2	0.0	0.0	0.09
		E-W	Somersville Road	West of Gentrytown Dr	35.0	34.8	35.0	34.8	0.0	0.0	0.4	0.4	0.4	0.4	0.0	0.0	0.24
		E-W	Del Oro Cir	Contra Loma Blvd	35.0	34.3	35.0	34.3	0.0	0.0	0.4	0.4	0.4	0.4	0.0	0.0	0.24
		E-W	East of Meadows Ave	Somersville Road	39.2	3.6	39.2	3.6	0.0	0.0	1.0	10.7	1.0	10.7	0.0	0.0	0.64
		E-W	Loveridge Road	Mcfaul Dr	34.5	19.3	34.5	19.2	0.0	-0.1	0.3	0.6	0.3	0.6	0.0	0.0	0.18
		E-W	East of Railroad Ave	Brookside Dr	34.7	14.3	34.7	14.2	0.0	-0.1	0.2	0.5	0.2	0.5	0.0	0.0	0.11
7	Contra Costa Blvd	N-S	Chilpancingo Pkwy	North of Golf Club Rd	34.9	34.8	34.9	34.8	0.0	0.0	0.2	0.2	0.2	0.2	0.0	0.0	0.13
		N-S	North of Hookston Rd	Boyd Rd	34.9	32.4	34.9	32.4	0.0	0.0	0.3	0.3	0.3	0.3	0.0	0.0	0.15
		N-S	Harriet Dr	Taylor Blvd	39.8	39.5	39.8	39.5	0.0	0.0	0.2	0.2	0.2	0.2	0.0	0.0	0.16
		N-S	2nd Ave	Center Ave	39.8	14.3	39.8	13.1	0.0	-1.2	0.2	0.5	0.2	0.5	0.0	0.0	0.12
		N-S	Oak Park Blvd	North of Oakpark Blvd	35.0	33.8	35.0	33.8	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.04
8	E 18th St	E-W	West of SR 160	Phillips Ln	34.9	34.7	34.9	34.7	0.0	0.0	0.4	0.4	0.4	0.4	0.0	0.0	0.25
		E-W	Cavallo Road	Biglow Dr.	34.9	8.4	34.9	7.5	0.0	-0.9	0.3	1.1	0.3	1.3	0.0	0.1	0.16
		E-W	Vineyard Dr	Willow Ave	34.9	34.2	34.9	34.2	0.0	0.0	0.4	0.4	0.4	0.4	0.0	0.0	0.24
9	Hillcrest Ave	N-S	Interchange (North of SR 4)	SR 4	29.6	30.0	29.6	30.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.02
		N-S	South of Larkspur Dr	North of Davison Dr	29.0	29.9	29.1	29.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.02
10	James Donlon Blvd	E-W	Contra Loma Blvd	Blythe Dr	35.0	34.8	35.0	34.8	0.0	0.0	0.6	0.6	0.6	0.6	0.0	0.0	0.33
		E-W	S Royal Links Cir	Lone Tree Way	34.9	34.7	34.9	34.7	0.0	0.0	0.4	0.4	0.4	0.4	0.0	0.0	0.25

No.	Name	Direction	Cross Street 1	Cross Street 2	2015 AM Congested Speed (mph)						2015 AM Travel Time (min.)						Length (mile)
					Baseline		With Ramp Metering		Difference		Baseline		With Ramp Metering		Difference		
					NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	
11	Kirker Pass Rd	N-S	Concord Blvd	Kirkwood Dr	39.9	38.7	39.9	38.7	0.0	0.0	0.3	0.3	0.3	0.3	0.0	0.0	0.22
		N-S	Nortonville Rd	North of Hess Rd	39.9	16.8	39.9	16.4	0.0	-0.4	1.4	3.3	1.4	3.3	0.0	0.1	0.91
		N-S	Castlewood Dr	Pheasant Dr	29.9	11.1	29.9	10.9	0.0	-0.2	0.4	1.0	0.4	1.0	0.0	0.0	0.18
12	Leland Rd	E-W	Railroad Ave	West of Presidio Ln	34.9	34.5	34.9	34.5	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.07
		E-W	Crestview Dr	Railroad Ave	34.9	34.6	34.9	34.6	0.0	0.0	0.5	0.5	0.5	0.5	0.0	0.0	0.31
		E-W	John Johnson Pkwy	West of Golf Club Rd	39.9	38.8	39.9	38.8	0.0	0.0	0.3	0.4	0.3	0.4	0.0	0.0	0.23
		E-W	Willow Ave	Bailey Rd	39.9	30.7	39.9	31.0	0.0	0.3	0.1	0.1	0.1	0.1	0.0	0.0	0.05
13	Lone Tree Wy	N-S	Worrell Rd	Hillside Rd	33.4	34.9	33.6	34.9	0.1	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.07
		N-S	South of Clearbrook Rd	Davison Dr	28.8	30.0	28.9	30.0	0.1	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.05
14	Pacheco Blvd	N-S	Blum Road	South of Arnold Dr	28.8	10.7	28.6	10.4	-0.3	-0.3	0.4	1.1	0.4	1.2	0.0	0.0	0.20
		N-S	Muir Rd	Buchanan Cir	39.9	39.8	39.9	39.8	0.0	0.0	0.2	0.2	0.2	0.2	0.0	0.0	0.13
		N-S	1st Ave	Center Ave	39.9	38.5	39.9	38.3	0.0	-0.2	0.2	0.2	0.2	0.2	0.0	0.0	0.13
15	Pittsburg-Antioch Hwy	E-W	Verne Roberts Cir	Auto Center Dr	8.3	39.3	8.3	39.3	0.0	-0.1	3.7	0.8	3.7	0.8	0.0	0.0	0.51
		E-W	Loveridge Road	Columbia St	39.8	19.6	39.8	18.2	0.0	-1.4	1.2	2.5	1.2	2.7	0.0	0.2	0.82
		E-W	Loveridge Road	California Ave	34.8	2.6	34.8	2.5	0.0	-0.1	1.3	16.7	1.3	17.2	0.0	0.5	0.73
16	Somersville Rd	N-S	Century Blvd	Sycamore Dr	30.0	29.9	30.0	29.9	0.0	0.0	0.2	0.2	0.2	0.2	0.0	0.0	0.08
		N-S	Delta Fair Blvd	Fairview Dr	29.9	30.0	29.9	30.0	0.0	0.0	0.3	0.3	0.3	0.3	0.0	0.0	0.15
17	Treat Blvd	E-W	I-680	Oak Rd	29.9	29.6	29.9	29.6	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.07
		E-W	East of Oak Grove Rd	Blarney Ave	30.0	29.4	30.0	29.4	0.0	0.0	0.4	0.4	0.4	0.4	0.0	0.0	0.21
		E-W	Sheppard Rd	Cherry Ln	29.8	7.6	29.8	7.6	0.0	0.0	0.3	1.1	0.3	1.1	0.0	0.0	0.14
		E-W	Arkell Rd	Winton Dr	30.0	29.2	30.0	29.2	0.0	0.0	0.4	0.5	0.4	0.5	0.0	0.0	0.22
18	Willow Pass Rd	N-S	SR-4	Avila Road	36.3	14.4	36.3	14.4	0.0	0.1	0.5	1.3	0.5	1.3	0.0	0.0	0.32
		N-S	Port Chicago Highway	West of Parkside Dr	29.9	29.8	29.9	29.8	0.0	0.0	0.4	0.4	0.4	0.4	0.0	0.0	0.19
		N-S	I-680	Diamond Blvd	29.8	29.9	29.8	29.9	0.0	0.0	0.2	0.2	0.2	0.2	0.0	0.0	0.10
		N-S	Market St	Fry Way	29.9	29.9	29.9	29.9	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.07
		N-S	Mt. Diablo St	Concord Ave	29.9	29.6	29.9	29.6	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.07
19	Ygnacio Valley Rd	N-S	Walnut Ave	Wimbledon Rd	34.9	34.9	34.9	34.9	0.0	0.0	0.5	0.5	0.5	0.5	0.0	0.0	0.32
		N-S	Oakland Blvd	California Blvd	34.5	34.9	34.5	34.9	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.06
		N-S	Cowell Road	North of Oak Grove Road	34.9	2.7	34.9	2.7	0.0	0.0	1.5	19.5	1.5	19.5	0.0	0.0	0.88
		N-S	East of Civic Dr	Walnut Blvd	29.7	28.6	29.7	28.6	0.0	0.0	0.2	0.3	0.2	0.3	0.0	0.0	0.12
		N-S	Broadway	Main St	29.8	29.7	29.8	29.7	0.0	0.0	0.2	0.2	0.2	0.2	0.0	0.0	0.12
20	Imhoff Dr	E-W	Waterbird Way	Solano Way	40.0	39.9	40.0	39.9	0.0	0.0	1.4	1.4	1.4	1.4	0.0	0.0	0.94
21	Clayton Road	E-W	5th St	Davis Avenue	34.9	9.1	34.9	9.2	0.0	0.1	0.4	1.5	0.4	1.4	0.0	0.0	0.22
		E-W	Ayers Road	Ygnacio Valley Rd	30.0	29.8	30.0	29.8	0.0	0.0	0.4	0.4	0.4	0.4	0.0	0.0	0.21

No.	Name	Direction	Cross Street 1	Cross Street 2	2015 AM Congested Speed (mph)						2015 AM Travel Time (min.)						Length (mile)
					Baseline		With Ramp Metering		Difference		Baseline		With Ramp Metering		Difference		
					NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	
22	Evora Road	E-W	Willow Pass Rd	Driftwood Rd	39.9	8.0	39.9	7.6	0.0	-0.4	0.5	2.6	0.5	2.7	0.0	0.1	0.34
23	Loveridge Rd	N-S	California Ave	Pittsburg-Antioch Highway	34.9	34.8	34.9	34.8	0.0	0.0	0.4	0.4	0.4	0.4	0.0	0.0	0.25
		N-S	SR-4	Leland Road	34.3	34.7	34.3	34.7	0.0	0.0	0.2	0.2	0.2	0.2	0.0	0.0	0.13
24	California Ave	E-W	Railroad Ave	Avon Street	29.7	27.4	29.7	27.2	0.0	-0.2	0.4	0.4	0.4	0.4	0.0	0.0	0.19
		E-W	SR-4 (westbound ramp)	Carion Court	29.9	24.2	29.9	24.2	0.0	0.0	0.5	0.7	0.5	0.7	0.0	0.0	0.27

Note: "-" difference indicates a decrease with ramp metering conditions.

Exhibit 57: Arterial Segments – PM Peak Hour Volume Comparison

No.	Name	Direction	Cross Street 1	Cross Street 2	Lanes		2015 PM Peak Volume (vph)						2015 PM Peak Hour (Volume / Capacity)					
							Baseline		With Ramp Metering		Difference		Baseline		With Ramp Metering		Difference	
					NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB
1	10th St	E-W	H St	G St	1	1	1049	256	1054	256	5	0	**1.10**	0.27	**1.11**	0.27	0.01	0.00
		E-W	L St	K St	1	1	1093	305	1098	304	5	-1	**1.15**	0.32	**1.16**	0.32	0.01	0.00
		E-W	K St	H St	1	1	1023	248	1028	248	5	0	**1.14**	0.28	**1.14**	0.28	0.01	0.00
2	18th St	E-W	A St	Alpha Way	1	1	953	243	962	243	10	0	1.00	0.26	**1.01**	0.26	0.01	0.00
		E-W	Alpha Way	Crestwood Dr	1	1	962	286	974	286	11	0	**1.01**	0.30	**1.02**	0.30	0.01	0.00
		E-W	Crestwood Dr	Cavallo Road	1	1	1084	371	1098	371	14	0	**1.14**	0.39	**1.16**	0.39	0.02	0.00
3	9th St	E-W	C St	D St	1	1	166	58	166	58	0	0	0.24	0.08	0.24	0.08	0.00	0.00
		E-W	A St	C St	1	1	229	87	229	87	0	0	0.33	0.12	0.33	0.12	0.00	0.00
4	Alhambra Ave	N-S	Alhambra Valley Road	Kim Ct	1	1	763	776	758	782	-5	6	0.80	0.82	0.80	0.82	-0.01	0.01
		N-S	North of SR 4	North of Walnut Ave	2	2	1411	1740	1412	1733	1	-7	0.78	0.97	0.78	0.96	0.00	0.00
		N-S	Franklin Canyon Road	South of SR 4	1	1	697	648	701	654	5	6	0.73	0.68	0.74	0.69	0.01	0.01
5	Bailey Rd	N-S	Leland Rd	Maylard St	2	3	898	1938	899	1942	1	3	0.50	0.72	0.50	0.72	0.00	0.00
		N-S	Willow Pass Road	Placer Dr	2	2	745	665	742	663	-3	-2	0.39	0.35	0.39	0.35	0.00	0.00
		N-S	North of Maylard St	S. of SR 4 (S. of On-ramp)	2	3	1621	1566	1622	1569	1	4	0.90	0.58	0.90	0.58	0.00	0.00
		N-S	North of SR 4	Canal Road	2	2	2315	1116	2311	1119	-4	3	**1.22**	0.59	**1.22**	0.59	0.00	0.00
6	Buchanan Rd	E-W	Railroad Ave	West of Book Side Dr	1	1	1203	679	1202	679	-1	0	**1.27**	0.71	**1.26**	0.71	0.00	0.00
		E-W	Somersville Road	West of Gentrytown Dr	2	2	973	387	975	396	2	9	0.51	0.20	0.51	0.21	0.00	0.00
		E-W	Del Oro Cir	Contra Loma Blvd	2	2	1354	490	1353	497	-1	7	0.71	0.26	0.71	0.26	0.00	0.00
		E-W	East of Meadows Ave	Somersville Road	1	1	1465	570	1470	570	4	0	**1.54**	0.60	**1.55**	0.60	0.00	0.00
		E-W	Loveridge Road	Mcfaul Dr	1	1	933	834	931	834	-2	0	0.98	0.88	0.98	0.88	0.00	0.00
		E-W	East of Railroad Ave	Brookside Dr	1	1	886	637	884	637	-2	0	0.93	0.67	0.93	0.67	0.00	0.00
7	Contra Costa Blvd	N-S	Chilpancingo Pkwy	North of Golf Club Rd	2	2	1783	1331	1754	1335	-29	3	0.94	0.70	0.92	0.70	-0.02	0.00
		N-S	North of Hookston Rd	Boyd Rd	2	2	1905	1113	1903	1110	-2	-3	1.00	0.59	1.00	0.58	0.00	0.00
		N-S	Harriet Dr	Taylor Blvd	2	2	1912	1521	1908	1516	-4	-6	0.98	0.78	0.97	0.77	0.00	0.00
		N-S	2nd Ave	Center Ave	2	2	2027	1415	2027	1424	0	9	**1.03**	0.72	**1.03**	0.73	0.00	0.00
		N-S	Oak Park Blvd	North of Oakpark Blvd	2	2	841	693	841	698	0	5	0.44	0.36	0.44	0.37	0.00	0.00
8	E 18th St	E-W	West of SR 160	Phillips Ln	1	1	531	359	545	359	14	0	0.56	0.38	0.57	0.38	0.01	0.00
		E-W	Cavallo Road	Biglow Dr.	1	1	1064	361	1080	361	16	0	**1.12**	0.38	**1.14**	0.38	0.02	0.00
		E-W	Vineyard Dr	Willow Ave	1	1	656	226	668	226	12	0	0.69	0.24	0.70	0.24	0.01	0.00
9	Hillcrest Ave	N-S	Interchange (North of SR 4)	SR 4	3	3	1569	637	1565	637	-4	0	0.58	0.24	0.58	0.24	0.00	0.00
		N-S	South of Larkspur Dr	North of Davison Dr	3	3	1401	2404	1396	2398	-5	-5	0.52	0.89	0.52	0.89	0.00	0.00
10	James Donlon Blvd	E-W	Contra Loma Blvd	Blythe Dr	2	2	965	257	966	258	1	0	0.51	0.14	0.51	0.14	0.00	0.00
		E-W	S Royal Links Cir	Lone Tree Way	2	2	1208	717	1208	717	0	0	0.64	0.38	0.64	0.38	0.00	0.00

No.	Name	Direction	Cross Street 1	Cross Street 2	Lanes		2015 PM Peak Volume (vph)						2015 PM Peak Hour (Volume / Capacity)					
							Baseline		With Ramp Metering		Difference		Baseline		With Ramp Metering		Difference	
					NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB
11	Kirker Pass Rd	N-S	Concord Blvd	Kirkwood Dr	3	3	2560	888	2560	887	0	0	0.90	0.31	0.90	0.31	0.00	0.00
		N-S	Nortonville Rd	North of Hess Rd	2	2	1454	849	1454	849	0	0	0.77	0.45	0.77	0.45	0.00	0.00
		N-S	Castlewood Dr	Pheasant Dr	2	2	1514	1057	1514	1056	-1	-1	0.84	0.59	0.84	0.59	0.00	0.00
12	Leland Rd	E-W	Railroad Ave	West of Presidio Ln	2	2	1608	870	1610	870	2	0	0.85	0.46	0.85	0.46	0.00	0.00
		E-W	Crestview Dr	Railroad Ave	2	2	1480	821	1482	820	2	-1	0.78	0.43	0.78	0.43	0.00	0.00
		E-W	John Johnson Pkwy	West of Golf Club Rd	2	2	989	421	992	421	3	-1	0.52	0.22	0.52	0.22	0.00	0.00
		E-W	Willow Ave	Bailey Rd	2	2	2405	656	2409	656	4	0	**1.27**	0.35	**1.27**	0.35	0.00	0.00
13	Lone Tree Wy	N-S	Worrell Rd	Hillside Rd	2	2	724	1660	727	1663	2	3	0.38	0.87	0.38	0.88	0.00	0.00
		N-S	South of Clearbrook Rd	Davison Dr	2	2	646	1555	648	1557	2	3	0.36	0.86	0.36	0.87	0.00	0.00
14	Pacheco Blvd	N-S	Blum Road	South of Arnold Dr	1	1	1077	889	1077	900	0	11	**1.20**	0.99	**1.20**	1.00	0.00	0.01
		N-S	Muir Rd	Buchanan Cir	2	2	816	679	811	686	-5	7	0.43	0.36	0.43	0.36	0.00	0.00
		N-S	1st Ave	Center Ave	2	2	1470	1218	1464	1224	-5	6	0.77	0.64	0.77	0.64	0.00	0.00
15	Pittsburg-Antioch Hwy	E-W	Verne Roberts Cir	Auto Center Dr	1	1	702	1248	707	1248	5	0	0.74	**1.31**	0.74	**1.31**	0.01	0.00
		E-W	Loveridge Road	Columbia St	1	1	914	297	915	297	2	0	0.96	0.31	0.96	0.31	0.00	0.00
		E-W	Loveridge Road	California Ave	1	1	1447	562	1452	562	5	0	**1.52**	0.59	**1.53**	0.59	0.01	0.00
16	Somersville Rd	N-S	Century Blvd	Sycamore Dr	3	3	1687	1580	1691	1580	4	0	0.62	0.59	0.63	0.59	0.00	0.00
		N-S	Delta Fair Blvd	Fairview Dr	2	2	243	479	245	469	2	-10	0.14	0.27	0.14	0.26	0.00	-0.01
17	Treat Blvd	E-W	I-680	Oak Rd	3	3	2061	1837	2046	1832	-15	-5	0.72	0.64	0.72	0.64	-0.01	0.00
		E-W	East of Oak Grove Rd	Blarney Ave	3	3	1817	694	1812	695	-5	1	0.64	0.24	0.64	0.24	0.00	0.00
		E-W	Sheppard Rd	Cherry Ln	3	3	4073	2480	4071	2483	-3	3	**1.39**	0.84	**1.38**	0.84	0.00	0.00
		E-W	Arkell Rd	Winton Dr	3	3	1921	1087	1930	1089	9	2	0.67	0.38	0.68	0.38	0.00	0.00
18	Willow Pass Rd	N-S	SR-4	Avila Road	1	1	1274	730	1267	729	-7	-1	**1.34**	0.77	**1.33**	0.77	-0.01	0.00
		N-S	Port Chicago Highway	West of Parkside Dr	2	2	1561	428	1546	425	-15	-2	0.87	0.24	0.86	0.24	-0.01	0.00
		N-S	I-680	Diamond Blvd	3	3	1848	2066	1840	2065	-8	0	0.68	0.77	0.68	0.76	0.00	0.00
		N-S	Market St	Fry Way	3	3	1720	1098	1721	1098	1	0	0.60	0.39	0.60	0.39	0.00	0.00
		N-S	Mt. Diablo St	Concord Ave	2	2	1460	709	1456	710	-4	0	0.81	0.39	0.81	0.39	0.00	0.00
19	Ygnacio Valley Rd	N-S	Walnut Ave	Wimbledon Rd	3	3	264	249	262	248	-2	-1	0.09	0.09	0.09	0.09	0.00	0.00
		N-S	Oakland Blvd	California Blvd	3	3	1803	2780	1824	2783	21	3	0.63	0.98	0.64	0.98	0.01	0.00
		N-S	Cowell Road	North of Oak Grove Road	2	2	3176	1004	3184	1004	8	1	**1.67**	0.53	**1.68**	0.53	0.00	0.00
		N-S	East of Civic Dr	Walnut Blvd	3	3	3431	1654	3431	1654	0	0	**1.20**	0.58	**1.20**	0.58	0.00	0.00
		N-S	Broadway	Main St	3	3	2106	1911	2130	1932	24	21	0.78	0.71	0.79	0.72	0.01	0.01
20	Imhoff Dr	E-W	Waterbird Way	Solano Way	2	2	280	151	294	151	14	0	0.15	0.08	0.15	0.08	0.01	0.00
21	Clayton Road	E-W	5th St	Davis Avenue	2	2	2145	757	2147	745	2	-11	**1.13**	0.40	**1.13**	0.39	0.00	-0.01
		E-W	Ayers Road	Ygnacio Valley Rd	3	3	1322	634	1316	634	-5	0	0.49	0.23	0.49	0.23	0.00	0.00

No.	Name	Direction	Cross Street 1	Cross Street 2	Lanes		2015 PM Peak Volume (vph)						2015 PM Peak Hour (Volume / Capacity)					
							Baseline		With Ramp Metering		Difference		Baseline		With Ramp Metering		Difference	
					NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB
22	Evora Road	E-W	Willow Pass Rd	Driftwood Rd	1	1	924	347	921	348	-2	0	0.97	0.37	0.97	0.37	0.00	0.00
23	Loveridge Rd	N-S	California Ave	Pittsburg-Antioch Highway	2	2	824	809	826	807	2	-2	0.43	0.43	0.43	0.42	0.00	0.00
		N-S	SR-4	Leland Road	2	2	1364	1169	1357	1167	-7	-3	0.72	0.62	0.71	0.61	0.00	0.00
24	California Ave	E-W	Railroad Ave	Avon Street	1	1	323	633	322	632	-2	-1	0.40	0.79	0.40	0.79	0.00	0.00
		E-W	SR-4 (westbound ramp)	Carion Court	1	1	432	91	431	91	-1	0	0.54	0.11	0.54	0.11	0.00	0.00

Note: "-" difference indicates a decrease with ramp metering conditions.

Exhibit 58: Arterial Segments – PM Peak Hour Congested Speed and Travel Time Comparison

No.	Name	Direction	Cross Street 1	Cross Street 2	2015 PM Congested Speed (mph)						2015 PM Travel Time (min.)						Length (mile)
					Baseline		With Ramp Metering		Difference		Baseline		With Ramp Metering		Difference		
					NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	
1	10th St	E-W	H St	G St	11.8	34.8	11.4	34.8	-0.4	0.0	0.4	0.1	0.4	0.1	0.0	0.0	0.07
		E-W	L St	K St	9.3	34.8	9.1	34.8	-0.2	0.0	0.4	0.1	0.5	0.1	0.0	0.0	0.07
		E-W	K St	H St	9.5	29.8	9.3	29.8	-0.3	0.0	1.2	0.4	1.2	0.4	0.0	0.0	0.19
2	18th St	E-W	A St	Alpha Way	22.8	34.8	21.4	34.8	-1.4	0.0	0.8	0.5	0.8	0.5	0.1	0.0	0.29
		E-W	Alpha Way	Crestwood Dr	21.4	34.8	19.7	34.8	-1.7	0.0	0.2	0.1	0.2	0.1	0.0	0.0	0.08
		E-W	Crestwood Dr	Cavallo Road	9.8	34.7	9.1	34.7	-0.7	0.0	0.9	0.2	0.9	0.2	0.1	0.0	0.14
3	9th St	E-W	C St	D St	34.8	34.9	34.8	34.9	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.07
		E-W	A St	C St	34.7	34.9	34.7	34.9	0.0	0.0	0.3	0.3	0.3	0.3	0.0	0.0	0.15
4	Alhambra Ave	N-S	Alhambra Valley Road	Kim Ct	37.5	37.3	37.6	37.2	0.1	-0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.07
		N-S	North of SR 4	North of Walnut Ave	29.3	26.1	29.3	26.4	0.0	0.2	0.2	0.2	0.2	0.2	0.0	0.0	0.10
		N-S	Franklin Canyon Road	South of SR 4	33.6	33.9	33.6	33.9	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.04
5	Bailey Rd	N-S	Leland Rd	Maylard St	29.8	29.7	29.8	29.7	0.0	0.0	0.2	0.2	0.2	0.2	0.0	0.0	0.09
		N-S	Willow Pass Road	Placer Dr	34.8	34.9	34.8	34.9	0.0	0.0	0.3	0.3	0.3	0.3	0.0	0.0	0.16
		N-S	North of Maylard St	S. of SR 4 (S. of On-ramp)	28.3	29.8	28.3	29.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.01
		N-S	North of SR 4	Canal Road	7.2	34.6	7.2	34.6	0.1	0.0	0.5	0.1	0.5	0.1	0.0	0.0	0.06
6	Buchanan Rd	E-W	Railroad Ave	West of Book Side Dr	6.1	33.8	6.1	33.8	0.0	0.0	0.9	0.2	0.9	0.2	0.0	0.0	0.09
		E-W	Somersville Road	West of Gentrytown Dr	34.7	34.9	34.7	34.9	0.0	0.0	0.4	0.4	0.4	0.4	0.0	0.0	0.24
		E-W	Del Oro Cir	Contra Loma Blvd	34.4	34.9	34.4	34.9	0.0	0.0	0.4	0.4	0.4	0.4	0.0	0.0	0.24
		E-W	East of Meadows Ave	Somersville Road	3.4	39.0	3.3	39.0	0.0	0.0	11.4	1.0	11.5	1.0	0.1	0.0	0.64
		E-W	Loveridge Road	Mcfaul Dr	25.6	31.8	25.8	31.8	0.2	0.0	0.4	0.3	0.4	0.3	0.0	0.0	0.18
		E-W	East of Railroad Ave	Brookside Dr	29.8	34.0	29.8	34.0	0.1	0.0	0.2	0.2	0.2	0.2	0.0	0.0	0.11
7	Contra Costa Blvd	N-S	Chilpancingo Pkwy	North of Golf Club Rd	31.7	34.4	32.3	34.4	0.6	0.0	0.2	0.2	0.2	0.2	0.0	0.0	0.13
		N-S	North of Hookston Rd	Boyd Rd	25.3	34.6	25.5	34.6	0.2	0.0	0.4	0.3	0.4	0.3	0.0	0.0	0.15
		N-S	Harriet Dr	Taylor Blvd	32.7	38.9	32.9	38.9	0.2	0.0	0.3	0.2	0.3	0.2	0.0	0.0	0.16
		N-S	2nd Ave	Center Ave	21.3	39.2	21.4	39.2	0.0	0.0	0.3	0.2	0.3	0.2	0.0	0.0	0.12
		N-S	Oak Park Blvd	North of Oakpark Blvd	34.8	34.9	34.8	34.9	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.04
8	E 18th St	E-W	West of SR 160	Phillips Ln	34.4	34.7	34.3	34.7	0.0	0.0	0.4	0.4	0.4	0.4	0.0	0.0	0.25
		E-W	Cavallo Road	Biglow Dr.	10.8	34.7	10.0	34.7	-0.9	0.0	0.9	0.3	1.0	0.3	0.1	0.0	0.16
		E-W	Vineyard Dr	Willow Ave	33.9	34.8	33.8	34.8	-0.1	0.0	0.4	0.4	0.4	0.4	0.0	0.0	0.24
9	Hillcrest Ave	N-S	Interchange (North of SR 4)	SR 4	29.8	30.0	29.8	30.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.02
		N-S	South of Larkspur Dr	North of Davison Dr	29.9	29.0	29.9	29.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.02
10	James Donlon Blvd	E-W	Contra Loma Blvd	Blythe Dr	34.7	35.0	34.7	35.0	0.0	0.0	0.6	0.6	0.6	0.6	0.0	0.0	0.33
		E-W	S Royal Links Cir	Lone Tree Way	34.6	34.8	34.6	34.8	0.0	0.0	0.4	0.4	0.4	0.4	0.0	0.0	0.25

No.	Name	Direction	Cross Street 1	Cross Street 2	2015 PM Congested Speed (mph)						2015 PM Travel Time (min.)						Length (mile)
					Baseline		With Ramp Metering		Difference		Baseline		With Ramp Metering		Difference		
					NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	
11	Kirker Pass Rd	N-S	Concord Blvd	Kirkwood Dr	38.2	39.9	38.2	39.9	0.0	0.0	0.3	0.3	0.3	0.3	0.0	0.0	0.22
		N-S	Nortonville Rd	North of Hess Rd	38.9	39.7	38.9	39.7	0.0	0.0	1.4	1.4	1.4	1.4	0.0	0.0	0.91
		N-S	Castlewood Dr	Pheasant Dr	29.0	29.7	29.0	29.7	0.0	0.0	0.4	0.4	0.4	0.4	0.0	0.0	0.18
12	Leland Rd	E-W	Railroad Ave	West of Presidio Ln	33.7	34.8	33.6	34.8	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.07
		E-W	Crestview Dr	Railroad Ave	34.1	34.8	34.1	34.8	0.0	0.0	0.5	0.5	0.5	0.5	0.0	0.0	0.31
		E-W	John Johnson Pkwy	West of Golf Club Rd	39.6	39.9	39.6	39.9	0.0	0.0	0.3	0.3	0.3	0.3	0.0	0.0	0.23
		E-W	Willow Ave	Bailey Rd	6.3	39.8	6.3	39.8	0.0	0.0	0.5	0.1	0.5	0.1	0.0	0.0	0.05
13	Lone Tree Wy	N-S	Worrell Rd	Hillside Rd	34.8	33.3	34.8	33.3	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.07
		N-S	South of Clearbrook Rd	Davison Dr	29.9	28.8	29.9	28.8	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.05
14	Pacheco Blvd	N-S	Blum Road	South of Arnold Dr	7.5	22.1	7.5	20.8	0.0	-1.3	1.6	0.5	1.6	0.6	0.0	0.0	0.20
		N-S	Muir Rd	Buchanan Cir	39.7	39.8	39.8	39.8	0.0	0.0	0.2	0.2	0.2	0.2	0.0	0.0	0.13
		N-S	1st Ave	Center Ave	38.9	39.4	38.9	39.4	0.0	0.0	0.2	0.2	0.2	0.2	0.0	0.0	0.13
15	Pittsburg-Antioch Hwy	E-W	Verne Roberts Cir	Auto Center Dr	38.2	5.4	38.1	5.4	0.0	0.0	0.8	5.6	0.8	5.6	0.0	0.0	0.51
		E-W	Loveridge Road	Columbia St	30.7	39.7	30.5	39.7	-0.2	0.0	1.6	1.2	1.6	1.2	0.0	0.0	0.82
		E-W	Loveridge Road	California Ave	3.4	34.3	3.4	34.3	0.0	0.0	12.8	1.3	12.9	1.3	0.1	0.0	0.73
16	Somersville Rd	N-S	Century Blvd	Sycamore Dr	29.8	29.8	29.8	29.8	0.0	0.0	0.2	0.2	0.2	0.2	0.0	0.0	0.08
		N-S	Delta Fair Blvd	Fairview Dr	30.0	29.9	30.0	29.9	0.0	0.0	0.3	0.3	0.3	0.3	0.0	0.0	0.15
17	Treat Blvd	E-W	I-680	Oak Rd	29.7	29.8	29.7	29.8	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.07
		E-W	East of Oak Grove Rd	Blarney Ave	29.8	30.0	29.8	30.0	0.0	0.0	0.4	0.4	0.4	0.4	0.0	0.0	0.21
		E-W	Sheppard Rd	Cherry Ln	4.4	29.4	4.4	29.4	0.0	0.0	1.9	0.3	1.9	0.3	0.0	0.0	0.14
		E-W	Arkell Rd	Winton Dr	29.7	29.9	29.7	29.9	0.0	0.0	0.4	0.4	0.4	0.4	0.0	0.0	0.22
18	Willow Pass Rd	N-S	SR-4	Avila Road	5.1	37.9	5.2	37.9	0.1	0.0	3.8	0.5	3.7	0.5	-0.1	0.0	0.32
		N-S	Port Chicago Highway	West of Parkside Dr	28.8	29.9	28.8	29.9	0.1	0.0	0.4	0.4	0.4	0.4	0.0	0.0	0.19
		N-S	I-680	Diamond Blvd	29.7	29.6	29.7	29.6	0.0	0.0	0.2	0.2	0.2	0.2	0.0	0.0	0.10
		N-S	Market St	Fry Way	29.8	29.9	29.8	29.9	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.07
		N-S	Mt. Diablo St	Concord Ave	29.2	29.9	29.2	29.9	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.07
19	Ygnacio Valley Rd	N-S	Walnut Ave	Wimbledon Rd	35.0	35.0	35.0	35.0	0.0	0.0	0.5	0.5	0.5	0.5	0.0	0.0	0.32
		N-S	Oakland Blvd	California Blvd	34.7	30.5	34.7	30.4	0.0	-0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.06
		N-S	Cowell Road	North of Oak Grove Road	2.7	34.7	2.7	34.7	0.0	0.0	19.3	1.5	19.4	1.5	0.1	0.0	0.88
		N-S	East of Civic Dr	Walnut Blvd	7.3	29.8	7.3	29.8	0.0	0.0	1.0	0.2	1.0	0.2	0.0	0.0	0.12
		N-S	Broadway	Main St	29.5	29.7	29.5	29.7	0.0	0.0	0.2	0.2	0.2	0.2	0.0	0.0	0.12
20	Imhoff Dr	E-W	Waterbird Way	Solano Way	39.9	40.0	39.9	40.0	0.0	0.0	1.4	1.4	1.4	1.4	0.0	0.0	0.94
21	Clayton Road	E-W	5th St	Davis Avenue	10.5	34.8	10.5	34.8	-0.1	0.0	1.3	0.4	1.3	0.4	0.0	0.0	0.22
		E-W	Ayers Road	Ygnacio Valley Rd	29.9	30.0	29.9	30.0	0.0	0.0	0.4	0.4	0.4	0.4	0.0	0.0	0.21

No.	Name	Direction	Cross Street 1	Cross Street 2	2015 PM Congested Speed (mph)						2015 PM Travel Time (min.)						Length (mile)
					Baseline		With Ramp Metering		Difference		Baseline		With Ramp Metering		Difference		
					NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	
22	Evora Road	E-W	Willow Pass Rd	Driftwood Rd	29.5	39.6	29.8	39.6	0.3	0.0	0.7	0.5	0.7	0.5	0.0	0.0	0.34
23	Loveridge Rd	N-S	California Ave	Pittsburg-Antioch Highway	34.8	34.8	34.8	34.8	0.0	0.0	0.4	0.4	0.4	0.4	0.0	0.0	0.25
		N-S	SR-4	Leland Road	34.4	34.6	34.4	34.6	0.0	0.0	0.2	0.2	0.2	0.2	0.0	0.0	0.13
24	California Ave	E-W	Railroad Ave	Avon Street	29.1	25.8	29.1	25.8	0.0	0.0	0.4	0.4	0.4	0.4	0.0	0.0	0.19
		E-W	SR-4 (westbound ramp)	Carion Court	28.5	29.8	28.5	29.8	0.0	0.0	0.6	0.5	0.6	0.5	0.0	0.0	0.27

Note: "-" difference indicates a decrease with ramp metering conditions.

7.3. INTERSECTIONS

Exhibit 59 and Exhibit 60 provide comparisons of intersection v/c ratios between 2015 baseline and with ramp metering conditions for ramp terminal intersections, as well as other key intersections along potential diversion routes. As shown in the exhibit, implementation of the ramp metering plan would result in minor diversion traffic at these facilities as shown by the differences in resulting v/c ratios for each intersection. The difference in volumes would not degrade intersection LOS letter grade at any location. The maximum v/c ratio increase is approximate 0.01 during the AM peak hour and 0.02 during the PM peak hour, while a number of locations would experience decrease in v/c ratio due to traffic diverted away from those locations. Detailed Traffix LOS calculation sheets are included in Appendix G.

Exhibit 59: Intersection LOS Comparison between 2015 Baseline and Ramp Metering Conditions for Ramp Intersections

	Location	Jurisdiction	2015 Baseline				2015 with Ramp Meter				V/C Difference	
			AM		PM		AM		PM			
			LOS	V/C	LOS	V/C	LOS	V/C	LOS	V/C	AM	PM
1	SR 4 WB On-Ramp & Alhambra Ave	Martinez	C	0.72	C	0.72	C	0.71	C	0.72	-0.02	0.00
2	SR 4 EB On-Ramp & Alhambra Ave	Martinez	B	0.65	A	0.57	B	0.64	A	0.57	-0.01	0.00
3	SR 4 WB On-Ramp & Pine St	Martinez	A	0.46	A	0.49	A	0.43	A	0.49	-0.03	0.00
4	SR 4 EB On-Ramp & Center Ave	Martinez	A	0.42	B	0.60	A	0.42	A	0.58	0.00	-0.03
5	SR 4 WB On-Ramp & Morello Ave	Martinez	A	0.44	A	0.44	A	0.42	A	0.44	-0.02	0.00
6	SR 4 EB On-Ramp & Morello Ave	Martinez	A	0.40	A	0.52	A	0.40	A	0.52	-0.01	-0.01
7	SR 4 WB On-Ramp & Pacheco Blvd	Martinez	A	0.47	B	0.61	A	0.45	B	0.61	-0.02	0.00
8	SR 4 WB On-Ramp/Solano Way & Arnold Industrial Way/Imhoff Dr	Concord	A	0.47	B	0.63	A	0.47	B	0.63	0.00	0.01
9	SR 4 WB On-Ramp & Port Chicago Hwy	Concord	D	0.90	C	0.76	D	0.90	C	0.77	0.00	0.00
10	SR 4 WB On-Ramp & Willow Pass Rd	Bay Point	A	0.55	A	0.37	A	0.55	A	0.37	0.00	0.00
11	SR 4 EB On-Ramp & San Marco Blvd	Bay Point	A	0.41	B	0.66	A	0.41	B	0.66	0.00	0.00
12	SR 4 WB On-Ramp & Bailey Rd	Pittsburg	D	0.85	D	0.84	D	0.85	D	0.84	0.00	0.00
13	SR 4 EB On-Ramp & Bailey Rd	Pittsburg	A	0.43	C	0.78	A	0.43	C	0.78	0.00	0.00
14	SR 4 WB On-Ramp & Railroad Ave	Brentwood	B	0.61	B	0.64	B	0.62	B	0.64	0.01	0.00
15	SR 4 EB On-Ramp & Railroad Ave	Pittsburg	B	0.63	C	0.75	B	0.63	C	0.75	0.00	0.00
16	SR 4 WB On-Ramp & California Ave	Pittsburg	A	0.40	A	0.57	A	0.40	A	0.57	0.00	0.00
17	SR 4 EB On-Ramp & Loveridge Rd	Pittsburg	A	0.56	A	0.54	A	0.55	A	0.53	0.00	-0.01
18	SR 4 WB On-Ramp & Somersville Rd	Antioch	A	0.41	A	0.53	A	0.41	A	0.53	0.00	0.00
19	SR 4 EB On-Ramp & Somersville Rd	Antioch	A	0.41	B	0.64	A	0.41	B	0.64	0.00	-0.01
20	SR 4 WB On-Ramp & A St	Brentwood	A	0.43	A	0.56	A	0.43	A	0.56	-0.01	0.00
21	SR 4 EB On-Ramp & Lone Tree Way	Antioch	A	0.33	A	0.54	A	0.32	A	0.53	-0.01	-0.01
22	SR 4 WB On-Ramp & Hillcrest Ave	Antioch	A	0.27	A	0.39	A	0.27	A	0.39	-0.01	0.00
23	SR 4 EB On-Ramp & Hillcrest Ave	Antioch	A	0.43	A	0.56	A	0.43	A	0.56	0.00	-0.01
24	SR 242 SB On-Ramp & Solano Way	Concord	B	0.64	A	0.51	B	0.63	A	0.51	-0.01	0.00

Location		Jurisdiction	2015 Baseline				2015 with Ramp Meter				V/C Difference	
			AM		PM		AM		PM			
			LOS	V/C	LOS	V/C	LOS	V/C	LOS	V/C	AM	PM
25	SR 242 SB On-Ramp/Commerce Ave & Concord Ave	Concord	D	0.89	**F**	**1.01**	D	0.89	**F**	**1.01**	0.00	0.00
26	SR 242 NB On-Ramp/Market St & Concord Ave	Concord	A	0.54	B	0.68	A	0.53	B	0.67	0.00	-0.01
27	SR 242 SB On-Ramp & Clayton Rd	Concord	C	0.71	C	0.72	B	0.69	C	0.72	-0.02	0.00

Note: "-" difference indicates a decrease with ramp metering conditions.

Exhibit 60: Intersection LOS Comparison between 2015 Baseline and Ramp Metering Conditions for Intersections Away From Freeway

Location		Jurisdiction	2015 Baseline				2015 with Ramp Meter				Diff. in V/C (with Ramp Meter - Baseline)	
			AM		PM		AM		PM			
			LOS	V/C	LOS	V/C	LOS	V/C	LOS	V/C	AM	PM
28	Pacheco Blvd & Morello Ave	Martinez	B	0.62	B	0.68	B	0.62	B	0.68	0.01	0.00
29	Pacheco Blvd & Arthur Rd	Martinez	A	0.43	A	0.48	A	0.43	A	0.48	0.00	0.00
30	Contra Costa Blvd & Chilpancingo Parkway	Pleasant Hill	B	0.65	D	0.82	B	0.64	D	0.82	-0.01	0.00
31	Concord Ave & Diamond Blvd	Concord	A	0.38	A	0.59	A	0.38	A	0.59	0.00	0.00
32	Contra Costa Blvd & Sunvalley Blvd/Willow Pass Rd	Pleasant Hill	A	0.48	C	0.71	A	0.49	C	0.71	0.00	0.00
33	I-680 NB On-Ramp & Willow Pass Rd	Concord	A	0.55	C	0.79	A	0.55	C	0.79	0.00	0.00
34	Diamond Blvd & Willow Pass Rd	Concord	A	0.37	B	0.61	A	0.37	B	0.61	0.00	0.01
35	Willow Pass Rd & Market St	Concord	A	0.53	B	0.62	A	0.52	B	0.62	0.00	0.00
36	Port Chicago Hwy & Olivera Rd	Concord	C	0.74	C	0.79	C	0.74	D	0.81	0.00	0.02
37	Port Chicago Hwy & Willow Pass Rd (South)	Concord	A	0.53	A	0.42	A	0.53	A	0.41	-0.01	0.00
38	Willow Pass Rd & Galindo St	Concord	B	0.63	C	0.79	B	0.62	C	0.79	-0.01	0.00
39	Port Chicago Hwy & Willow Pass Rd (North)	Bay Point	B	0.65	A	0.42	B	0.64	A	0.42	0.00	0.00
40	Willow Pass Rd & Bailey Rd	Bay Point	A	0.56	B	0.63	A	0.56	B	0.63	0.00	0.00
41	Bailey Rd & W Leland Rd	Bay Point	D	0.84	B	0.65	D	0.83	B	0.66	-0.01	0.00
42	Tenth St & Railroad Ave	Pittsburg	A	0.44	A	0.47	A	0.44	A	0.47	0.00	0.00
43	Railroad Ave & Buchanan Rd	Pittsburg	C	0.72	A	0.56	C	0.72	A	0.56	0.00	0.00
44	Auto Center Dr & W 10th St	Antioch	A	0.59	B	0.66	A	0.59	B	0.66	0.01	0.00
45	Buchanan Rd & Somersville Rd	Antioch	D	0.84	B	0.67	D	0.85	B	0.68	0.01	0.01
46	Lone Tree Way & Ridgerock Dr/John Donlon Blvd	Antioch	D	0.87	C	0.78	D	0.87	C	0.78	0.00	0.00

Location		Jurisdiction	2015 Baseline				2015 with Ramp Meter				Diff. in V/C (with Ramp Meter - Baseline)	
			AM		PM		AM		PM			
			LOS	V/C	LOS	V/C	LOS	V/C	LOS	V/C	AM	PM
47	E 18th St/Main St & Route 160 On-Ramp	Antioch	A	0.24	A	0.33	A	0.24	A	0.33	0.00	0.00
48	Bailey Rd & Concord Blvd	Concord	B	0.67	A	0.59	B	0.67	A	0.59	0.00	0.00
49	Clayton Rd & Treat Blvd	Concord	C	0.72	D	0.81	C	0.72	D	0.81	0.00	0.00
50	Ygnacio Valley Rd/Kirker Pass Rd & Clayton Rd	Concord	B	0.61	A	0.57	B	0.61	A	0.57	0.00	0.00
51	Ygnacio Valley Rd & Oak Grove Rd	Walnut Creek	**F**	**1.04**	D	0.88	**F**	**1.04**	D	0.89	0.00	0.01
52	California Ave & Loveridge Rd	Pittsburg	B	0.69	A	0.59	B	0.68	A	0.59	-0.01	0.00
53	W Leland Road & Railroad Ave	Pittsburg	C	0.75	**E**	**0.92**	C	0.74	**E**	**0.92**	0.00	0.00

Note: "-" difference indicates a decrease with ramp metering conditions.

7.4. AREAWIDE MOBILITY COMPARISON

Exhibit 61 presents differences in area-wide mobility performance measures within the study area between 2015 baseline and 2015 with ramp metering conditions.

Ramp meters result in benefits to the overall system performance measures as indicated by reductions in vehicle hours of delays and vehicle miles of travel (VMT), as well as increase in average system mean speeds during both AM and PM peak hours. VMT would be reduced as a result of shorter travel distance for certain origin-destination pairs, as those trips divert as a result of ramp metering effects. For example, during the morning peak hour, a portion of the short local trips between Lone Tree Way/A Street and Somersville Road near SR 4 would prefer to stay on local parallel street such as Buchanan Road to travel in the westbound direction, rather than taking a longer distance route using SR 4 with ramp metering.

Exhibit 61: 2015 Baseline - Study Area Study Performance Measures Comparison

	Study Area							East County in Study Area							Central County in Study Area						
	VMT	VHT	VHD	Mean Speed (mph)	PMT	PHT	PHD	VMT	VHT	VHD	Mean Speed (mph)	PMT	PHT	PHD	VMT	VHT	VHD	Mean Speed (mph)	PMT	PHT	PHD
Baseline																					
AM Peak Hour	899,905	31,953	10,417	28.16	990,691	34,522	11,017	277,974	9,290	2,602	29.92	302,285	9,921	2,692	621,931	22,663	7,815	27.44	688,406	24,601	8,324
PM Peak Hour	978,031	30,943	7,057	31.61	1,111,706	34,764	7,714	308,587	9,255	1,715	33.34	349,798	10,356	1,800	669,444	21,688	5,341	30.87	761,908	24,408	5,915
With Ramp Metering																					
AM Peak Hour	897,078	31,749	10,335	28.26	987,511	34,301	10,929	278,126	9,275	2,594	29.99	302,401	9,907	2,686	618,953	22,474	7,741	27.54	685,109	24,394	8,243
PM Peak Hour	973,910	30,535	6,800	31.90	1,106,943	34,296	7,418	308,429	9,226	1,693	33.43	349,512	10,320	1,775	665,481	21,309	5,106	31.23	757,432	23,975	5,643
Difference																					
AM Peak Hour - Difference	-2,826	-204	-82	0.09	-3,181	-220	-87	152	-15	-8	0.07	116	-14	-6	-2,979	-189	-74	0.10	-3,297	-206	-81
AM Peak Hour - % Difference	-0.31%	-0.64%	-0.79%	0.33%	-0.32%	-0.64%	-0.79%	0.05%	-0.16%	-0.32%	0.22%	0.04%	-0.14%	-0.22%	-0.48%	-0.83%	-0.95%	0.36%	-0.48%	-0.84%	-0.97%
PM Peak Hour - Difference	-4,121	-408	-257	0.29	-4,763	-469	-297	-158	-29	-22	0.09	-287	-36	-25	-3,963	-379	-235	0.36	-4,476	-433	-271
PM Peak Hour - % Difference	-0.42%	-1.32%	-3.64%	0.91%	-0.43%	-1.35%	-3.84%	-0.05%	-0.32%	-1.29%	0.26%	-0.08%	-0.34%	-1.40%	-0.59%	-1.75%	-4.40%	1.18%	-0.59%	-1.77%	-4.59%

Exhibit 62 and Exhibit 63 provide an area-wide system performance comparison for ramp metering effects under 2030 baseline and 2030 unconstrained conditions, respectively.

Ramp meters result in benefits to the overall system performance measures for both 2030 baseline and 2030 unconstrained conditions as indicated by reductions in vehicle hours of delay and vehicle miles of travel, as well as increases in average system mean speeds during both AM and PM peak hours.

Exhibit 62: 2030 Baseline - Study Area Study Performance Measures Comparison

	Study Area							East County in Study Area							Central County in Study Area						
	VMT	VHT	VHD	Mean Speed (mph)	PMT	PHT	PHD	VMT	VHT	VHD	Mean Speed (mph)	PMT	PHT	PHD	VMT	VHT	VHD	Mean Speed (mph)	PMT	PHT	PHD
Baseline																					
AM Peak Hour	1,254,577	58,012	28,151	21.63	1,392,352	62,314	29,641	429,007	16,276	6,332	26.36	471,853	17,386	6,573	825,570	41,736	21,819	19.78	920,498	44,928	23,068
PM Peak Hour	1,347,767	49,558	16,951	27.20	1,540,464	55,287	18,400	468,975	14,406	3,311	32.55	534,961	16,062	3,491	878,793	35,152	13,640	25.00	1,005,503	39,224	14,909
With Ramp Metering																					
AM Peak Hour	1,252,386	56,988	27,213	21.99	1,390,041	61,231	28,652	428,724	15,986	6,074	26.86	471,419	17,073	6,295	823,663	41,003	21,138	20.10	918,622	44,158	22,357
PM Peak Hour	1,347,334	49,247	16,671	27.37	1,539,915	54,954	18,099	468,365	14,302	3,240	32.76	534,087	15,942	3,408	878,968	34,945	13,432	25.16	1,005,828	39,012	14,690
Difference																					
AM Peak Hour - Difference	-2,191	-1,023	-938	0.37	-2,310	-1,083	-989	-283	-290	-258	0.50	-435	-314	-278	-1,908	-733	-680	0.32	-1,876	-770	-712
AM Peak Hour - % Difference	-0.17%	-1.76%	-3.33%	1.69%	-0.17%	-1.74%	-3.34%	-0.07%	-1.78%	-4.07%	1.90%	-0.09%	-1.80%	-4.22%	-0.23%	-1.76%	-3.12%	1.60%	-0.20%	-1.71%	-3.09%
PM Peak Hour - Difference	-434	-310	-279	0.17	-549	-333	-301	-609	-104	-71	0.20	-874	-120	-83	175	-206	-208	0.16	325	-212	-218
PM Peak Hour - % Difference	-0.03%	-0.63%	-1.65%	0.62%	-0.04%	-0.60%	-1.64%	-0.13%	-0.72%	-2.15%	0.63%	-0.16%	-0.75%	-2.37%	0.02%	-0.59%	-1.53%	0.63%	0.03%	-0.54%	-1.46%

Exhibit 63: 2030 Unconstrained - Study Area Study Performance Measures Comparison

	Study Area							East County in Study Area							Central County in Study Area						
	VMT	VHT	VHD	Mean Speed (mph)	PMT	PHT	PHD	VMT	VHT	VHD	Mean Speed (mph)	PMT	PHT	PHD	VMT	VHT	VHD	Mean Speed (mph)	PMT	PHT	PHD
Unconstrained																					
AM Peak Hour	1,253,493	51,885	22,117	24.16	1,389,593	55,971	23,455	430,124	15,666	5,685	27.46	472,523	16,613	5,800	823,369	36,219	16,432	22.73	917,070	39,358	17,655
PM Peak Hour	1,349,323	45,871	13,406	29.42	1,538,705	51,364	14,706	474,646	14,428	3,219	32.90	539,406	15,992	3,352	874,678	31,443	10,186	27.82	999,299	35,372	11,353
With Ramp Metering																					
AM Peak Hour	1,249,561	50,727	21,124	24.69	1,385,471	54,748	22,404	428,342	15,341	5,427	27.98	470,643	16,266	5,523	821,219	35,387	15,697	23.26	914,828	38,483	16,881
PM Peak Hour	1,349,049	45,600	13,167	29.59	1,538,110	51,073	14,448	474,639	14,300	3,107	33.21	539,265	15,850	3,227	874,410	31,300	10,060	27.94	998,845	35,222	11,221
Difference																					
AM Peak Hour - Difference	-3,932	-1,157	-993	0.53	-4,122	-1,223	-1,051	-1,782	-326	-258	0.52	-1,880	-347	-277	-2,150	-832	-735	0.53	-2,242	-875	-774
AM Peak Hour - % Difference	-0.31%	-2.23%	-4.49%	2.18%	-0.30%	-2.18%	-4.48%	-0.41%	-2.08%	-4.54%	1.89%	-0.40%	-2.09%	-4.78%	-0.26%	-2.30%	-4.47%	2.31%	-0.24%	-2.22%	-4.38%
PM Peak Hour - Difference	-274	-271	-239	0.17	-595	-291	-258	-7	-129	-112	0.31	-141	-142	-125	-267	-142	-126	0.12	-454	-150	-133
PM Peak Hour - % Difference	-0.02%	-0.59%	-1.78%	0.59%	-0.04%	-0.57%	-1.75%	0.00%	-0.89%	-3.49%	0.94%	-0.03%	-0.88%	-3.73%	-0.03%	-0.45%	-1.24%	0.44%	-0.05%	-0.42%	-1.17%

8. IMPLEMENTATION PLAN

This report presented a ramp metering plan for Year 2015 conditions, as that is the anticipated schedule for completing the installation of ramp metering equipment along the entire SR 4 and SR 242 corridors within the study limits, and would be ready for activation.

Caltrans is in the process of repairing and upgrading existing equipment between Solano Way and Railroad Avenue along SR 4 in both directions. Construction activity for this section of SR 4 is anticipated to be complete in 2013, after which ramp meters would be ready for installation and activation. Evaluations conducted for this report demonstrated that substantial travel time savings on the freeway mainline would be achieved with the implementation of ramp metering along both corridors; therefore, it is recommended that ramp meters be activated as soon as possible. The recommended staging plan that takes advantage of the schedule of current or planned projects to repair and install ramp equipment along SR 4 and SR 242 is summarized as follows and illustrated graphically in Exhibit 64:

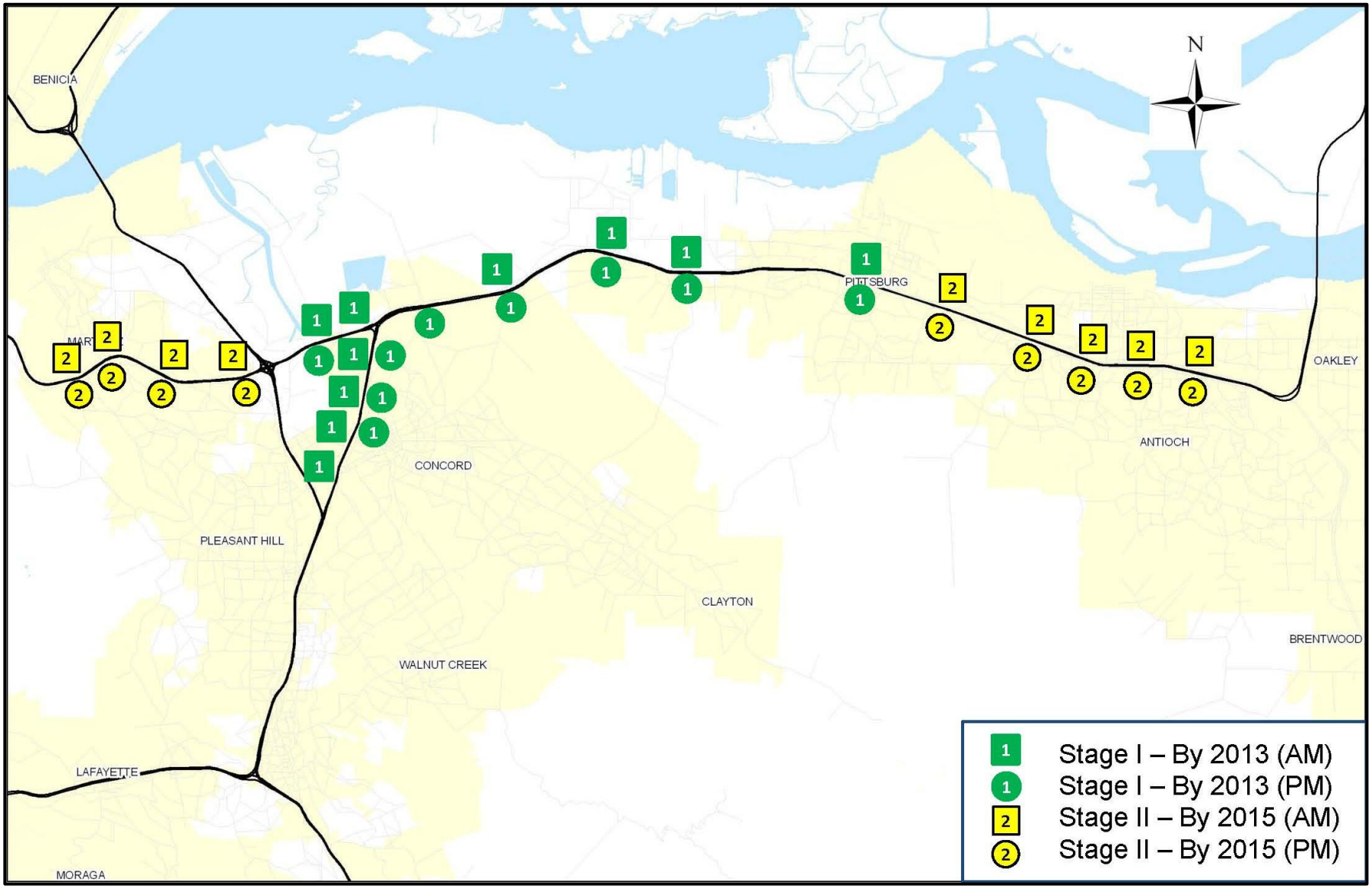
- Stage 1 – to be completed by 2013 with MTC and Caltrans' *Ramp Metering and TOS Equipment Repair and Replacement* Project:
  - SR 4 eastbound and westbound on-ramps between Solano Way and Railroad Avenue
  - SR 242 northbound on-ramps
  - SR 242 southbound on-ramps

- Stage 2 – to be completed by 2015 with MTC and Caltrans' next *Freeway Performance Initiative Program (FPI), and SR 4 Widening Projects:*
  - SR 4 eastbound and westbound on-ramps west of Solano Way and east of Railroad Avenue

8.1. NEXT STEPS

Draft metering rates and results presented in this report provide information necessary to evaluate the feasibility of activating ramp meters along the study corridors. It is necessary to collect more detailed freeway data prior to the actual activation; the data required would include mainline occupancy data (percent of time detectors are occupied) to develop detailed time of day plans to implement in the field. In addition, during the actual activation day, field crews would be stationed at each on-ramp location to observe and make field adjustments to metering rates as necessary based on observed conditions. Observations are typically made on multiple days during the opening week. Caltrans staff typically continues to monitor ramp meter operations periodically and as needed based on request.

Exhibit 64: Ramp Metering Implementation Stage Plan



APPENDICES

Appendix A: Existing Year Traffix LOS computation sheets

Appendix B: Detail 2015 Baseline Traffic Forecast Volumes for SR 4

Appendix C: Detail 2015 Baseline Traffic Forecast Volumes for SR 242

Appendix D: 2015 Baseline Traffix LOS computation sheets

Appendix E: Ramp Storage Graphics for SR 4 and SR 242

Appendix F: Details of Draft Metering Rates Development Process

Appendix G: 2015 With Ramp Metering Traffix LOS computation sheets

Appendix H: Synchro 2030 queuing analysis for Clayton Road and Treat Boulevard