I-680 Contra Costa Express Lanes Before/After Study

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BAIFA
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METROPOLITAN TRANSPORTATION COMMISSION

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Executive Summary

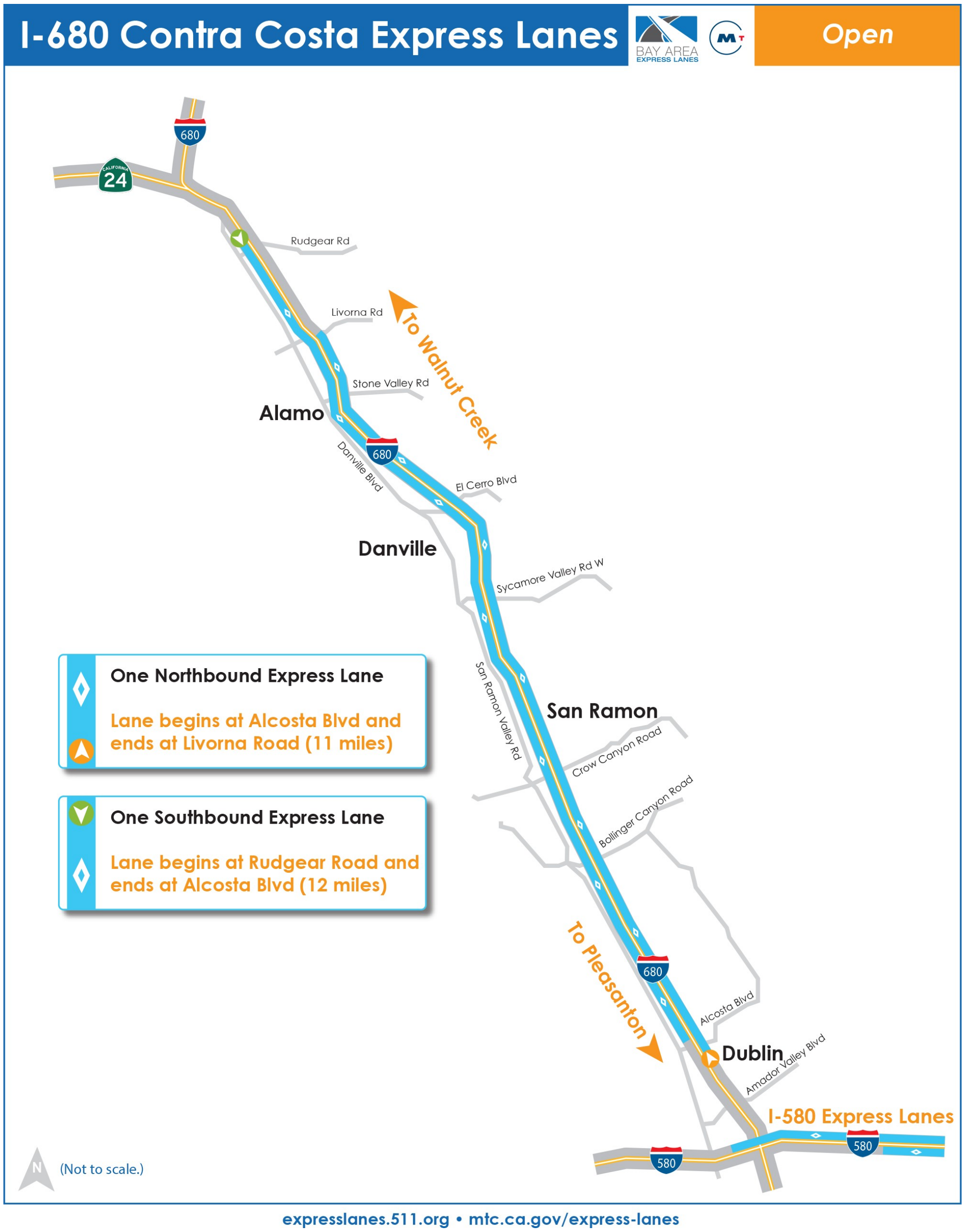
The Metropolitan Transportation Commission (MTC), in partnership with the Contra Costa Transportation Authority (CCTA) and Caltrans, opened the I-680 Express Lanes between Walnut Creek and San Ramon on October 9, 2017. This report summarizes an I-680 Express Lanes evaluation of conditions by establishing performance measures used to compare traffic data collected before the express lanes were implemented to data collected after the express lanes opened to the public. Overall, moderate improvements in many of the performance measures were observed across all lanes during the most congested travel period. Improvements such as reduced travel times, improved speeds, enhanced travel time reliability, reduced queue duration, and reduced travel delay served to improve travel through the corridor.

I-680 Express Lanes Background

The I-680 Express Lanes is the first project to be constructed within MTC's authorized 270-mile express lanes network, which represents one piece of the larger 600-mile Bay Area Express Lanes network. MTC's network was authorized by the California Transportation Commission (CTC) in 2011 pursuant to California Streets and Highways Code Section 149.5. Construction started in October of 2015 and the express lanes went operational on October 9, 2017.

The project involved converting high-occupancy vehicle (HOV) lanes to express lanes along northbound I-680 in Contra Costa County from Alcosta Boulevard to Livorna Road and along southbound I-680 from Rudgear Road to Alcosta Boulevard, resulting in 23 express lane miles through San Ramon, Danville, Alamo and southern Walnut Creek (see Figure ES - 1). The express lanes operate from 5am – 8pm and allow vehicles with two or more occupants and Clean Air Vehicles (CAVs) to continue to travel toll-free with a FasTrak Flex® toll tag set to a high-occupancy setting while solo drivers pay tolls that vary based on real-time traffic conditions. The lanes operate as "open access" lanes, allowing drivers to move into or out of the express lanes at any point.

Figure ES - 1: I-680 Express Lanes



The I-680 Express Lanes project represents the first phase of express lanes implementation within the I-680 corridor in Contra Costa County. Construction broke ground in October 2018 on a new project to extend the southbound express lane northward to Martinez and create a continuous southbound express lane through Contra Costa County. Studies to extend the northbound lane are ongoing.

Project Goals

The goals of the MTC express lanes program include providing connectivity, efficiency, and reliability as described below in Table ES - 1.

Table ES - 1: MTC Express Lane Program Goals

Goal	Description
Connectivity	Close gaps within the existing HOV lane system to increase travel time savings and reliability for carpools and buses. Express lanes provide a funding mechanism to expedite completion of this network of HOV lanes.
Efficiency	Optimize capacity in Bay Area freeway corridors to better meet current and future traffic demands. Efficiency of freeway facilities can be maximized by better using available capacity in the existing HOV system.
Reliability	Provide a reliable, congestion-free transportation option for buses, carpools, and single-occupant vehicles.

Evaluation Approach

Performance measures were developed to evaluate and compare the conditions prior to and after the implementation of the express lanes. Each measure was calculated using data collected from field observations and automated sources. Data representing conditions prior to the implementation of express lanes was collected in Fall 2014 and January 2017, when the lanes operated as HOV lanes. This “before” data was compared to data from late 2018, approximately one year after the express lanes opened. The data was used to calculate eleven performance measure, many of which were calculated separately for the general purpose lanes and for the express lanes, and even further broken down by direction of travel and peak period. The measures have been grouped into evaluation categories for reporting purposes (Table ES - 2), along with an overall assessment of how the express lane performed by category.

A full Before/After Study report describing the data collection and evaluation methodology is provided in Appendix A.

Table ES - 2: Evaluation Category and Related Performance Measures Summary

Evaluation Category	Evaluation Performance Measures	Express Lane Performance
Travel Time	• Travel Times and Speeds • Travel Time Reliability • Managed Lane Speed Assessment	↑ **Improved**
Delay	• Bottlenecks, Maximum Queue Length and Duration of Congestion • Delay • Vehicle-Hours of Delay (VHD) • Level of Service (LOS)	↑ **Improved**
Utilization	• Vehicle Occupancy and Classification • Vehicle Throughput • Person Throughput • Violations	↓↑ **Mixed Trends**

Conclusions

Data collected generally reveals an overall improvement in most performance measures when comparing 2014 data with 2018 data. However, some of this improvement is thought to be attributable to external factors resulting in overall changes in traffic patterns in the corridor. The effects of these external factors are apparent when comparing 2014 data to 2017 data, which shows a general improvement in many performance measures – such as travel time, travel time reliability, queue lengths, and travel delay – prior to the express lanes opening. Therefore, key takeaways regarding the impact of the express lanes are largely drawn by comparing the data collected immediately before and after the opening of the express lanes.

Comparing data collected in January 2017 to data collected in late 2018 generally reveals the following takeaways:

- In the most congested peak direction (northbound during the PM peak period), modest improvements in many of the performance measures were observed in both the express lane and general purpose lanes. These include improvements in average travel times and speeds, travel time reliability, queue duration, and delay. Level of service also improved, when compared to data collected in 2014.
- In the southbound direction during the AM peak period, performance measures for travel times and speeds, travel time reliability, queue duration, and delay held relatively steady before and after the implementation of the express lane.

1. INTRODUCTION

The Metropolitan Transportation Commission (MTC), in partnership with the Contra Costa Transportation Authority (CCTA) and Caltrans, opened the I-680 Express Lanes between Walnut Creek and San Ramon on October 9, 2017. The authorizing legislation for MTC's Express Lanes, including the I-680 Express Lanes, requires a report to the Legislature on the effect of the express lanes on overall corridor operations within three years after opening. Pursuant to that requirement, this report summarizes performance measures used to compare traffic data collected before the express lanes were implemented to data collected after the express lanes opened to the public.

1.1 Organization of the Report

This report is divided into the following sections:

- **Background** provides an overview of MTC's role in opening the I-680 Express Lanes and presents a background on the corridor and express lane operations.
- **Express Lanes Project Goals and Performance Measures** presents the performance measures used for the evaluation.
- **Data Collection and Evaluation Methodology** discusses the methodology and data collected for conducting the evaluation.
- **Evaluation Approach** presents the evaluation categories used for reporting.
- **Evaluation Results** presents the outcomes of the evaluation and key findings.
- **Conclusions** presents key findings as a result of the evaluation.

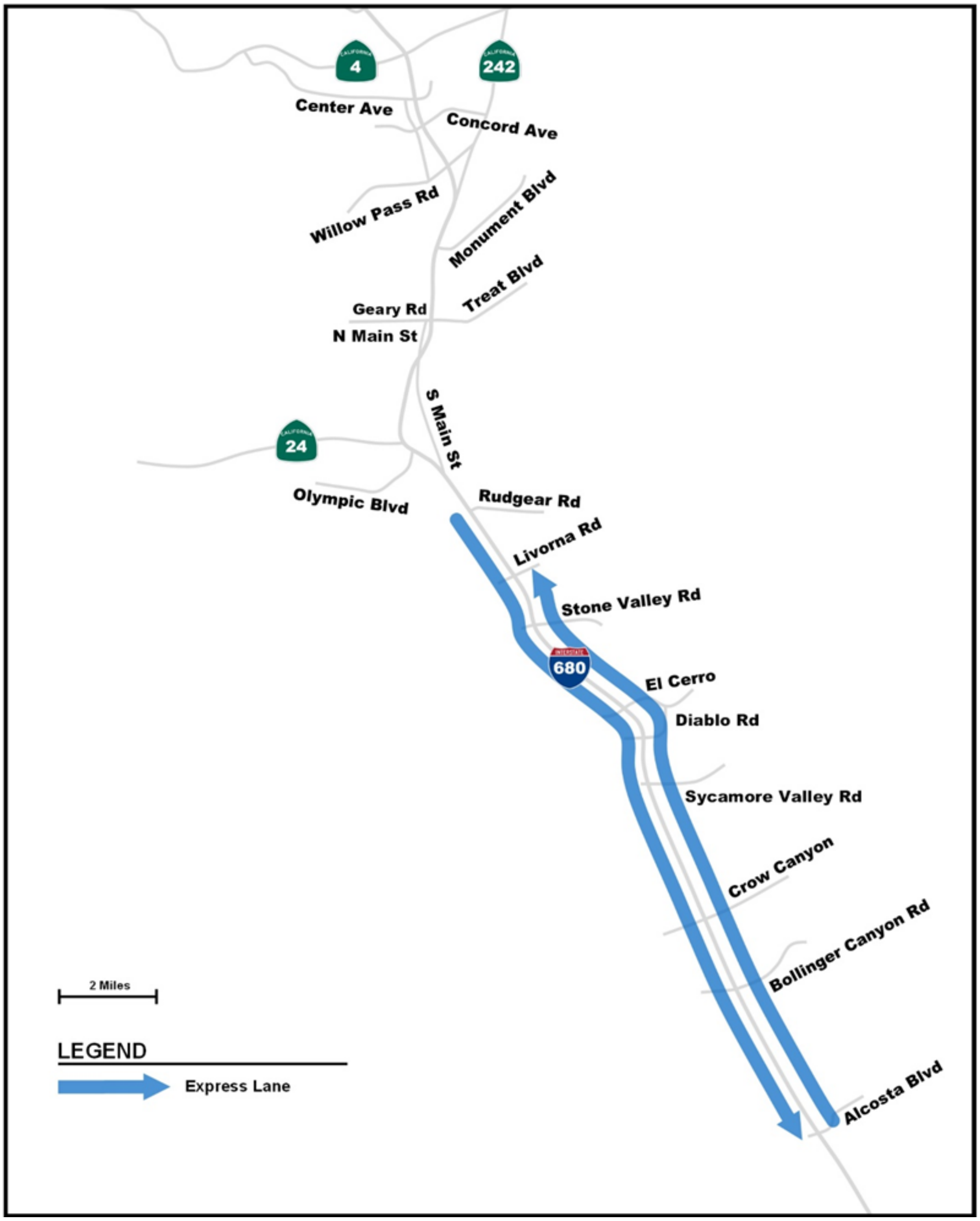
Appendix A presents more detailed information on the evaluation approach and data used for the analysis.

2. BACKGROUND

2.1 Project Description

MTC, in partnership with CCTA and Caltrans, opened the I-680 Express Lanes between Walnut Creek and San Ramon on October 9, 2017. The express lanes span a total of 23 lane-miles through San Ramon, Danville, Alamo and southern Walnut Creek in Contra Costa County (Figure 1). The 12-mile southbound express lane starts at Rudgear Road in Walnut Creek and ends at Alcosta Boulevard in San Ramon. The northbound express lane begins just before Alcosta Boulevard and extends 11 miles to Livorna Road in Alamo. Both lanes operate as "open access" lanes, allowing drivers to move into or out of the lanes at any time.

Figure 1: I-680 Express Lanes Project Limits



2.2 Current Express Lane Operating Parameters

The I-680 Express Lanes operate on weekdays from 5am to 8pm, allowing single occupant vehicles to choose to pay a toll for use of the lanes while vehicles with two or more occupants, eligible clean air vehicles[1], motorcycles, buses and vanpools can travel toll-free. Tolls for the lanes change dynamically based on traffic conditions at the time: tolls rise as traffic increases and tolls go down as traffic

[1] Starting October 2020, single-occupant eligible Clean Air Vehicles (CAVs) pay half-priced tolls on the I-680 Express Lanes.

decreases. In this way, the toll serves to manage demand by disincentivizing solo vehicle trips during congested periods.

Pricing signs located along the corridor display the toll to travel to up to two downstream destinations. The top price indicates the toll to travel to the end of the first toll zone at Crow Canyon Blvd and the bottom price indicates the price to travel to the end of the express lane, which is at Alcosta Blvd in the southbound direction and at Livorna Rd in the northbound direction. Drivers who exit the express lane prior to the end of a toll zone will be charged the full toll for that zone – this is designed to incentivize longer distance travel and to minimize weaving in and out of the express lane. Customers are locked in to the prices displayed on the pricing signs prior to entering the express lanes.

Figure 2: Pricing Sign

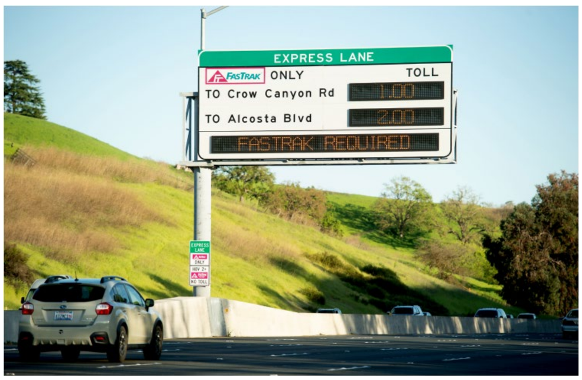


Figure 3: Close-up of Toll System Equipment (photo courtesy of Noah Berger)

Vehicles eligible for toll-free use of the express lanes are required to use a FasTrak Flex® toll tag set to the "2" or "3+" position. Solo drivers pay to use the lane with either a standard FasTrak® toll tag or a FasTrak Flex® toll tag se to the "1" position. Overhead electronic toll tag readers along the express lanes detect the toll tags and automatically charge the appropriate tolls to a user's FasTrak® account. Beacons mounted in the vicinity of the toll tag readers illuminate according to the FasTrak Flex® switch setting detected, which allow California Highway Patrol (CHP) to validate whether vehicles declaring as high-occupancy have two or more occupants.

2.3 Authorizing Legislation

The I-680 Express Lanes represents the first project to open in MTC's 270-mile express lanes network. MTC applied to the California Transportation Commission (CTC) for authority to implement and operate the express lanes network in 2011 pursuant to Streets and Highways Code Section 149.7. The authority that was granted included the following reporting requirement:

> *"Not later than three years after Agency first collects revenues from any of the projects, Agency shall submit a report to the legislature on its findings, conclusions, and recommendations concerning the demonstration program. The report shall include an analysis of the effect of the HOT lanes on the adjacent mixed-flow lanes and any comments submitted by the department and the department of the California Highway Patrol regarding operation of the lane."*

This report is intended to satisfy the requirement above by presenting the results of an evaluation to assess traffic conditions before and after the implementation of the I-680 Express Lanes.

3. EXPRESS LANES PROJECT GOALS AND PERFORMANCE MEASURES

3.1 Express Lanes Goals

The goals of the MTC Express Lanes program are identified below in Table 1 and include creating a more connected network for carpools and buses while improving efficiency and reliability.

Table 1: MTC Express Lane Program Goals

Goal	Description
Connectivity	Close gaps within the existing HOV lane system to increase travel time savings and reliability for carpools and buses. Express lanes provide a funding mechanism to expedite completion of this network of HOV lanes.
Efficiency	Optimize capacity in Bay Area freeway corridors to better meet current and future traffic demands. Efficiency of freeway facilities can be maximized by better using available capacity in the existing HOV system.
Reliability	Provide a reliable, congestion-free transportation option for buses, carpools, and single-occupant vehicles.

3.2 Performance Measures

Eleven performance measures (Table 2) were established to evaluate the operations of the I-680 corridor before and after the implementation of express lanes.

Table 2: Performance Measures

Performance Measures	
1	Travel Time and Speed
2	Delay
3	Bottlenecks, Maximum Queue Length and Duration of Congestion
4	Vehicle Occupancy and Classification
5	Vehicle Throughput
6	Person Throughput
7	Vehicle-Hours of Delay (VHD)
8	Level of Service (LOS)
9	Travel Time Reliability
10	Managed Lane Speed Assessment
11	Violations

4. DATA COLLECTION AND EVALUATION METHODOLOGY

The evaluation of the corridor performance measures relied on data collected and analyzed before and after the implementation of the express lanes. Most of the analysis came from data specifically collected for this study, but also included data compiled from other available sources. This section presents the performance measures and the data sources used to calculate each measure.

4.1 Data Collection

All the measures, except for Violations, required early data collection prior to implementation of the express lanes to establish the existing baseline conditions for the operation of the existing general purpose (GP) lanes and HOV lanes on I-680 prior to implementation of the express lanes. An initial set of baseline data was collected in late 2014 through early 2015. Given some delay in the opening of the express lanes, another set of baseline data was collected in early 2017 to provide an interim basis of comparison. Data collection was repeated approximately one year after the express lanes went into operation in late 2018.

- ***Baseline Periods***
  - **2014 Baseline =** October 2014 through November 2014; January 2015
  - **2017 Baseline =** late January 2017
- ***After Period***
  - **2018 After Period**: late October 2018 through mid-December 2018

Data collection consisted of field observations, travel time runs, and compilation of data from automated sources including Caltrans' Performance Measurement System (PeMS), INRIX, and toll tag data from the I-680 toll system. Data was largely collected during non-holiday, midweek days (Tuesday – Thursday) during AM peak periods (5:00 AM to 10:00 AM) and PM peak periods (3:00 PM to 7:00 PM); however, the time periods varied depending on the underlying data source for each particular performance measure (Table 3). To assess impacts separately, data was collected and reported for the HOV/express lane and the general purpose lanes. Data collected during periods of limited visibility or during the occurrence of anomalous conditions, such as roadway incidents, were excluded from summary calculations.

Prior to the express lane conversion, the HOV lanes operated from 5:00 AM to 9:00 AM and from 3:00 PM to 7:00 PM. Traffic data was collected for one additional hour in the AM peak period, resulting in a five-hour AM peak period and four-hour PM peak period for performance measure evaluation.

For vehicle occupancy, visibility constraints resulted in shorter periods for reliable data collection. Performance measures based on vehicle occupancy counts generally cover two hours during the AM peak period and two hours during the PM peak period.

Table 3: Performance Measure Time Periods

Performance Measure	AM Peak Period	PM Peak Period
3. Bottlenecks and Queues **4. Duration of Congestion** **6. Vehicle Throughput** **8. Vehicle-Hours of Delay** **9. Level of Service** **10. Travel Time Reliability**	5:00 AM to 10:00 AM	3:00 PM to 7:00 PM
1. Travel Times and Speeds **2. Delay** **11. Managed Lane Speed Assessment**	5:00 AM to 9:00 AM	3:00 PM to 7:00 PM
5. Vehicle Occupancy/Classification **7. Person Throughput**	7:00 AM to 9:00 AM	3:00 PM to 5:00 PM

Table 4 summarizes the data sources used to calculate each performance measure by facility type and for the 2014 Baseline, 2017 Baseline, and After Period. The field data collection locations of the traffic and occupancy counts are shown in Table 5. Additional details on the field data collection can be found in the Appendix.

Table 4: Performance Measures and Data Sources

	Performance Measures	Facility Type	Data Sources		
			2014 Baseline[2]	2017 Baseline[3]	After Period (2018[4])
1	**Travel Times and Speeds**	GP Lanes	INRIX	INRIX	INRIX
		HOV/Express Lanes	Floating Car Survey	Floating Car Survey	Floating Car Survey
2	**Delay**	GP Lanes	INRIX	INRIX	INRIX
		HOV/Express Lanes	Floating Car Survey	Floating Car Survey	Floating Car Survey
3	**Bottlenecks, Maximum Queue Length and Duration of Congestion**	GP Lanes	INRIX	INRIX	INRIX
		HOV/Express Lanes	Field Data	Field Data	Field Data
4	**Vehicle Occupancy and Classification**	GP Lanes	Field Data	Field Data	Field Data
		HOV/Express Lanes	Field Data	Field Data	Toll System
5	**Vehicle Throughput**	All Lanes	PeMS Wavetronix	PeMS Wavetronix	PeMS Wavetronix
6	**Person Throughput**	All Lanes	Field Data	Field Data	Field Data
7	**Vehicle-Hours of Delay (VHD)**	GP Lanes	INRIX Field Data	INRIX Field Data	INRIX Field Data
		HOV/Express Lanes	PeMS Field Data	PeMS Field Data	PeMS Field Data
8	**Level of Service (LOS)**	All Lanes	PeMS Field Data	PeMS Field Data	PeMS Field Data
9	**Travel Time Reliability**	GP Lanes	INRIX	INRIX	INRIX
		HOV/Express Lanes	PeMS	PeMS	PeMS
10	**Managed Lane Speed Assessment**	HOV/Express Lanes	PeMS	NA	PeMS
11	**Violations**	Express Lanes	NA	NA	Toll System

Note: INRIX data reports averages across all freeway lanes, including the HOV/Express lanes. A weighted averaging formula was used to determine travel times and speeds for the general purpose lanes only (see Section 4.2.1 Travel Times and Speeds).

Table 5: Traffic Count Data Collection Locations

Location	Manual Occupancy Counts	PeMS Counts	PeMS Speeds	Radar Counts	Throughput Analysis	Level of Service Analysis
NORTHBOUND						
Amador Valley Boulevard		●				
Alcosta Boulevard[5]	●	●			●	●
Bollinger Canyon Road[5]	●	●	●		●	●
Crow Canyon Road[5]	●	●	●		●	●
Greenbrook Drive[6]	●	●	●		●	●
Stone Valley Road		●	●			●
Livorna Road		●		●		
SOUTHBOUND						
South Main Street		●				
Livorna Road				●		
Stone Valley Road		●	●			●
Sycamore Valley Road[5]	●	●	●		●	●
Greenbrook Drive[6]	●	●	●		●	●
Norris Canyon Road[5]	●	●	●		●	●
Bollinger Canyon Road				●		
Amador Valley Boulevard		●				

4.2 Performance Measure Calculations

The following sections describe how the data collected was used to calculate the eleven performance measures that serve as the basis of comparison between the Baseline periods and the After Period.

4.2.1 Travel Times and Speeds

Travel times and speeds in the HOV/express lanes are reported based on "floating car" travel time surveys. The reported travel times and speeds represent the average of all travel time survey runs on all survey days wherever possible. The time periods for the floating car surveys were from 5:00 AM to 10:00 AM during the AM peak period and from 3:00 PM to 7:00 PM during the PM peak period for the time periods below:

- 2014 Baseline: October-November 2014; January 2015
- 2017 Baseline: January 24, 25 and 26
- 2018 After Period: November 27, 28, and 29

[2] Field collection dates: Oct 28 -30, 2014, Nov 5, 2014, Nov 6, 2014, Jan 13 – 15, 2015.
[3] Field collection dates: Jan 24-26, 2017
[4] Field collection dates: Oct 30, 2018, Nov 2018, Dec 4-13, 2018
[5] Occupancy counts conducted from overpass.
[6] Occupancy counts conducted from viewpoint adjacent to freeway.

INRIX data was used to report travel times and speeds for the general purpose. INRIX is a provider of real-time, historical, and predictive traffic information that works by combining anonymous, real-time GPS probe data from in-vehicle devices. The INRIX data includes a full year of midweek days (Tuesday to Thursday) for each study period as shown below:

- 2014 Baseline: February 1, 2014, to January 31, 2015
- 2017 Baseline: October 1, 2016, to September 30, 2017
- 2018 After Period: December 1, 2017, to November 30, 2018

The INRIX data represents the travel times and speeds in all lanes including the managed lanes. In order to derive the times and speeds for the general purpose lanes only, a formula to calculate a weighted average between the managed lanes and general purpose lanes was used. The calculation was done for the entire study corridor rather than subsegments, and separately for each 15-minute period.

$$\text{General Purpose Lanes Travel Time } = \frac{[\text{INRIX All Lanes Time}] \times [\text{PeMS All Lanes Volume}] - [\text{Floating Car Managed Lane Time}] \times [\text{PeMS Managed Lane Volume}]}{[\text{PeMS GP Lanes Volume}]}$$

4.2.2 Delay

Delay is calculated as the difference between actual observed travel times (from the floating car runs or INRIX data) and the free-flow travel time under uncongested conditions at 65 miles per hour.

4.2.3 Bottlenecks, Maximum Queues, Duration of Congestions

Bottlenecks and queues were identified using speed-contour maps created using the floating car travel time surveys on the HOV/express lanes and adjusted INRIX data on the general purpose lanes. Queue locations were identified as areas with noted speeds less than 35 mph. The duration of congestion was identified as the period of time during a peak period when speeds below 35 mph were observed.

4.2.4 Vehicle Occupancy/Classification

Vehicle occupancy analysis was based directly on manual counts conducted at locations throughout the corridor during the time periods below[7]:

- 2014 Baseline: October 29 and 30; November 5 and 6
- 2017 Baseline: January 24 and 26
- 2018 After Period: October 30; November 1, 6-8, 13, 15, 27-29; December 4-6, 11-13

The manual occupancy counts were used to estimate average vehicle occupancy and total person throughput.

4.2.5 Vehicle Throughput

Vehicle throughput is based primarily on Caltrans PeMS counts aggregated to 15-minute intervals. Twelve days of PeMS count data were used wherever possible for each location, representing four weeks of midweek (Tuesday to Thursday) days incorporating the days when occupancy and floating car

[7] Time periods with a high percentage of vehicles classified as “unknown” were excluded from calculations

surveys were conducted. In some cases, an incident or other anomaly occurred that made the data from one day not representative of average conditions. In those cases, the data from the non-representative day were excluded and the reported traffic counts represent the average of the results from the remaining days.

4.2.6 Person Throughput

The person throughput was calculated based on the vehicle throughput counts multiplied by the percentage of each vehicle occupancy classification from the manual occupancy counts, and then multiplied by the average vehicle occupancies for each vehicle type as listed in the Caltrans Managed Lanes reports. The calculation is done separately for each 15-minute period. Person throughput is only reported at locations and during time periods where vehicle occupancies were surveyed.

4.2.7 Vehicle Hours of Delay

Vehicle-hours of delay were calculated by multiplying the average delay during each 15-minute period by the representative vehicle throughput during that same period. The VHD for each hour period were calculated separately for the managed lanes and the GP lanes.

4.2.8 Level of Service

Level of Service (LOS) was evaluated based on the methodology outlined in the Highway Capacity Manual (HCM). LOS is based on vehicle density, which is the number of vehicles occupying a given length of a lane or roadway, and can range from LOS A (best) to LOS F (poorest) according to the criteria shown in Table 6. The LOS was calculated at 10 selected locations (5 northbound, 5 southbound) including the 7 locations where manual occupancy counts were available, plus 3 additional locations where PeMS counts were compiled.

Table 6: Highway Capacity Manual Freeway Level of Service Criteria

Level of Service	Density (passenger cars/mile/lane)
A	≤11.0
B	>11.0 – ≤18.0
C	>18.0 – ≤26.0
D	>26.0 – ≤35.0
E	>35.0 – ≤45.0
F	> 45.0

4.2.9 Travel Time Reliability

Travel time variability is used in this study to provide information on the reliability of travel times in the corridor. PeMS data was used to calculate reliability measures for the HOV/express lanes and INRIX data was used to calculate reliability measures for the general purpose lanes. Travel time reliability was measured by calculating the Travel Time Index (TTI) and Planning Time Index (PTI) separately for the HOV/express lanes and general purpose lanes as shown below:

- Travel Time Index = 50th percentile travel time divided by free-flow travel time. TTI provides an indicator of the average time compared to free-flow time
- Planning Time Index = 95th percentile travel time divided by free-flow travel time. PTI represents the extra time that travelers need to budget to reliably predict their travel time through the corridor

4.2.10 Managed Lane Speed Assessment

The managed lane speed assessment measures the performance of the HOV/express lanes with respect to the federal requirement defined in Section 166 of Title 23 of the US Code. This requirement defines the calculation of minimum average operating speed to determine whether an HOV/express lane facility is considered to be degraded. The requirement defines a degraded HOV/express lane facility as one that fails to maintain a minimum average operating speed of 45 mph 90 percent of the time over a consecutive 180-day period during morning or evening weekday peak periods.

PeMS data was used for the managed lane speed assessment. The PeMS data for selected detector stations in the corridor were compiled for all weekdays (Monday through Friday) between July 1 through December 31, in 2014 for the Before conditions and in 2018 for the After conditions. The average hourly speed measurements were reviewed for the hours of HOV operation (5:00 to 9:00 AM and 3:00 to 7:00 PM). The number of hours during the six-month (180+ day) period where the speed was less than 45 miles per hour were tabulated for each detector station and compared to the total number of peak period hours during the six-month period to determine the percentages for the speed assessment.

It should be noted that the methodology employed for the Managed Lane Speed Assessment may differ from that used by Caltrans in the annual California High-Occupancy Vehicle Lane Degradation Determination Report

4.2.11 Violations

Express lane violations were estimated for the After period only by comparing toll tag data with the manual occupancy counts. The toll tag data provided at four locations were compiled to represent the number of vehicles declaring themselves as single occupant, two person or three-plus persons for each 15-minute period during the AM and PM peak periods. Motorcycles and clean air vehicles (CAV) were assumed to use the 3+ toll tag setting. Image-based trips reported by the toll tag data were assumed to be single-occupant vehicles.

Violations were identified when the number of vehicles counted as single-occupant vehicles in the manual occupancy counts exceeded the number of single-occupant vehicles reported by the toll system. Two days of data were averaged where reliable manual counts were available for most of the four-hour peak periods for both days.

4.3 Performance Measure Groupings

The eleven performance measures described above were grouped into three evaluation categories for reporting purposes (Table 7). These categories are used throughout the report to organize and summarize the study findings.

Table 7: Evaluation Category and Related Performance Measures

Evaluation Category	Evaluation Performance Measures
Travel Time Trends	Travel Times and Speeds Travel Time Reliability Managed Lane Speed Assessment
Delay Trends	Bottlenecks, Maximum Queue Length and Duration of Congestion Delay Vehicle-Hours of Delay (VHD) Level of Service (LOS)
Utilization Trends	Vehicle Occupancy and Classification Vehicle Throughput Person Throughput Violations

Travel Time Trends include measures related to travel times, average speeds, and reliability metrics that represent performance of the corridor.

Delay Trends include measures that report on congestion and corresponding delays, and level of service at key locations along the corridor.

Utilization Trends measures report occupancy levels, the proportion of single occupant vehicles versus carpool eligible vehicles, and access mobility of vehicles and people through the corridor.

5. EVALUATION RESULTS

Overall, a comparison of performance measures between the 2014 and 2017 periods generally reveals an overall improvement in most performance measures, including travel time, travel time reliability, queue lengths, and travel delay. This suggests that there were external factors resulting in overall changes in traffic patterns in the corridor prior the express lanes being implemented. Therefore, key takeaways regarding the impact of the express lanes are largely drawn by comparing performance measures from the 2017 Baseline and the 2018 After Period, which are thought to more fairly capture the impacts of the express lanes on overall conditions in the corridor. Results are reported for the respective peak periods by direction, which include the AM peak period for the southbound direction and the PM peak period for the northbound direction.

This section presents the detailed findings for each of the performance measures.

5.1 Travel Time Trends

Travel time trends include measures related to travel times, average speeds, and reliability metrics that represent performance of the corridor.

5.1.1 Travel Times and Speeds

> ***The express lanes experienced improvements in travel times, travel speeds, and travel time savings, most notably in the northbound PM peak period, while the southbound AM peak period experienced minor variations from 2017 Baseline conditions. Similar results were also observed in the general purpose lanes.***

A summary of observed travel times and speeds in the HOV/express lanes is provided in Table 8, with general purpose lanes summarized in Table 9.

Table 8: Summary of Travel Time and Speed Trends (HOV/Express Lanes)

Performance Measure	Peak Period, Peak Direction	2014 Baseline	2017 Baseline	After Period (2018)
Travel Times; Speeds	AM Peak (SB)	9.8 min (max) (3.6 min savings); 56 mph (min)	9.7 min (max) (4.2 min savings); 57 mph (min)	**9.8 min (max) (3.6 min savings); 57 mph (min)**
	PM Peak (NB)	16.9 min (max) (8.9 min savings); 30 mph (min)	11.9 min (max) (3.8 min savings); 42 mph (min)	**10.9 min (max) (6.0 min savings); 46 mph (min)**

Legend: GREEN for improvement, YELLOW for minor variation, RED for worsening, BLACK for mixed trends

Table 9: Summary of Travel Time and Speed Trends (General Purpose Lanes)

Performance Measure	Peak Period, Peak Direction	2014 Baseline	2017 Baseline	After Period (2018)
Travel Times; Speeds	AM Peak (SB)	12.5 min (max) 43 mph (min)	13.3 min (max) 41 mph (min)	12.3 min **(max)** 44 mph **(min)**
	PM Peak (NB)	24.2 min (max) 20 mph (min)	15.1 min (max) 31 mph (min)	15.6 min **(max)** 31 mph **(min)**

Legend: GREEN for improvement, YELLOW for minor variation, RED for worsening, BLACK for mixed trends

HOV/Express Lanes

Northbound express lane travel times and speeds improved during the PM peak. As illustrated in Figure 4, travel times recorded for the 2017 Baseline regularly exceeded 10 minutes throughout the PM peak, but travel times largely dropped below 10 minutes after the express lane conversion. The time saving benefits also improved after the express lane conversion, with a maximum time savings of 3.8 minutes recorded in the HOV lane for the 2017 Baseline and a maximum time savings of 6.0 minutes recorded in the express lane.

Figure 5 shows that average speeds recorded for the 2017 Baseline were under 45 mph for more than an hour during the peak period, but average speeds recorded for the 2018 After Period were higher than 45 mph throughout the entire PM peak.

Southbound express lane travel times and speeds during the AM peak period were very similar to 2017 Baseline conditions.

Figure 4: Managed Lane PM Peak Period Travel Times, Northbound

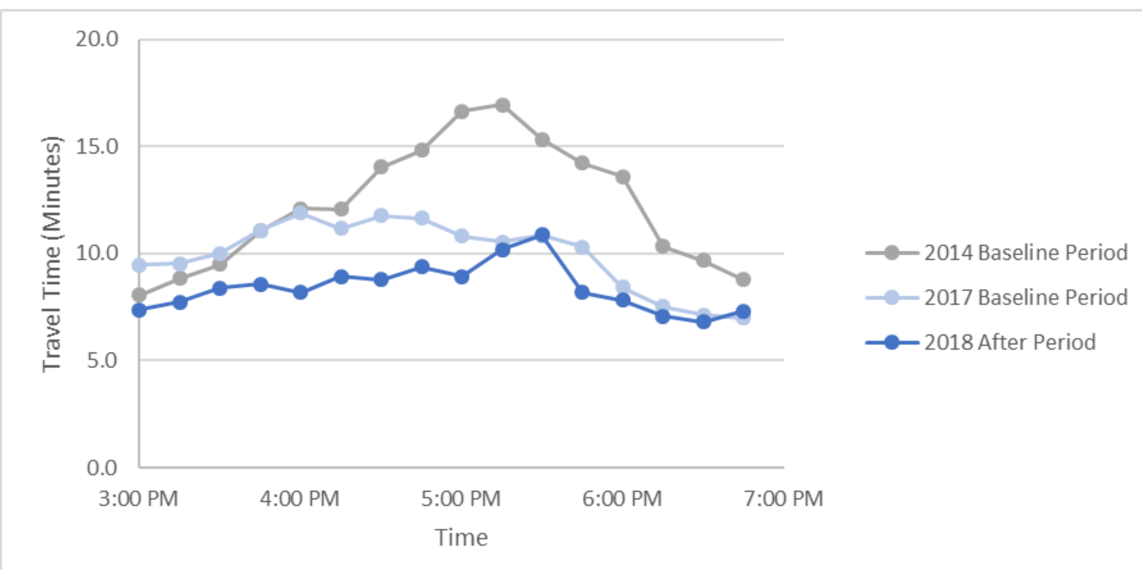
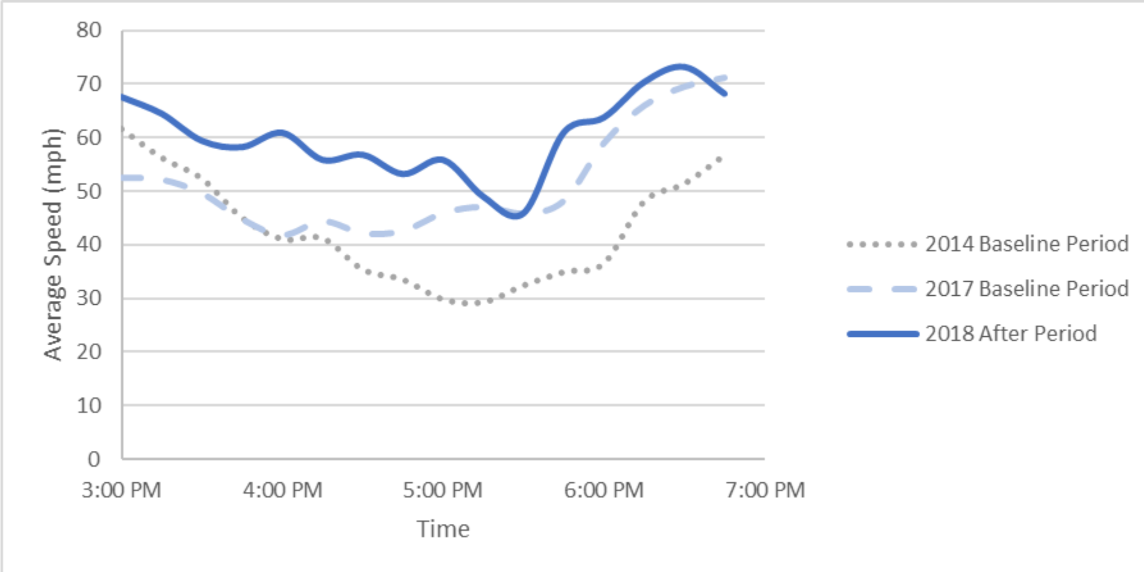


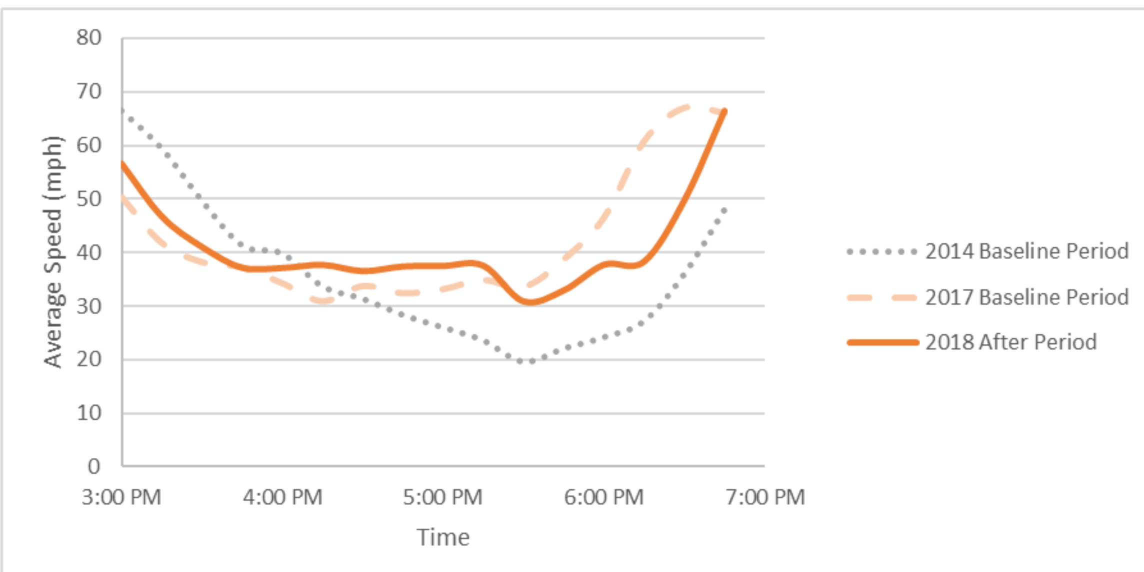
Figure 5: Managed Lane Average Speeds PM Peak Period, Northbound



General Purpose Lanes

There was little difference in travel times and speeds in the general purpose lanes before and after the implementation of express lanes. The most notable difference occurred in the northbound PM peak where average speeds were recorded below 35 mph for nearly two hours during the 2017 Baseline but were observed to drop below 35 mph for only 30 minutes after the express lane conversion (Figure 6).

Figure 6: General Purpose Lanes Average Speeds PM Peak Period, Northbound



5.1.2 Travel Time Reliability

Travel time reliability improved across all lanes for the most congested conditions, in the northbound PM peak period. Reliability in the southbound AM peak period remained consistent with 2017 Baseline conditions.

A comparison of Travel Time Index (50th percentile time divided by free-flow travel time) and Planning Time Index (95th percentile time divided by free-flow travel time) calculated across all freeway lanes is provided in Table 10.

Table 10: Summary of Travel Time Reliability Trends (All Lanes)

Performance Measure	Peak Period, Peak Direction	2014 Baseline	2017 Baseline	After Period (2018)
Travel Time Reliability (all lanes)	AM Peak (SB)	1.46 TTI (max) 1.96 PTI (max)	1.53 TTI (max) 1.80 PTI (max)	1.43 TTI **(max)** 1.71 PTI **(max)**
	PM Peak (NB)	2.26 TTI (max) 3.85 PTI (max)	2.06 TTI (max) 3.32 PTI (max)	**1.87 TTI (max)** **2.58 PTI (max)**

Legend: GREEN for improvement, YELLOW for minor variation, RED for worsening, BLACK for mixed trends

HOV/Express Lanes

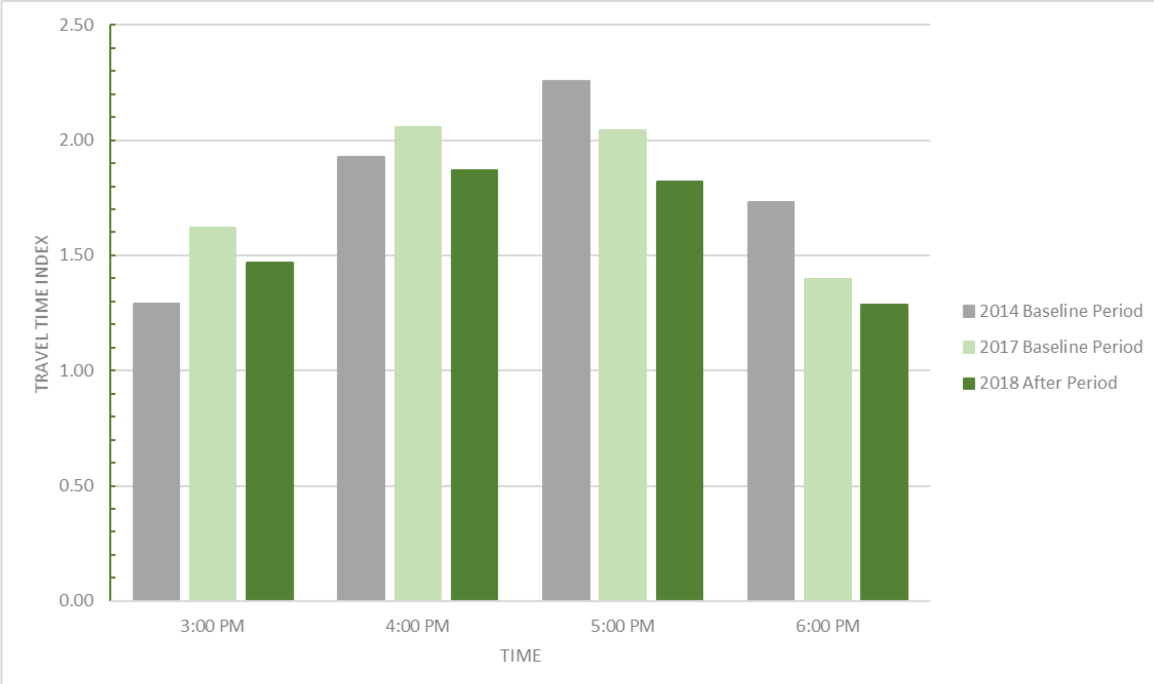
Travel time reliability, as measured by a comparison of the PeMS HOV/Express lane 95th percentile travel times, experienced a slight improvement in the northbound PM peak, indicating that the conversion to express lanes in the most congested portion of the corridor was able to improve the reliability of the existing HOV lane. Even more, the express lane is able to maintain superior reliability as compared to the adjacent general purpose lanes. In the express lane, 95th percentile travel times were observed to be no more than 60% higher than median travel times; however, in the general purpose lanes, 95th percentile travel times were observed to be as high as double the median travel time.

In the southbound AM peak, travel time reliability measures were not found to be significantly better or worse after the express lane conversion.

All Lanes

Travel time reliability was also calculated across all lanes using INRIX data. Moderate improvement in reliability was observed in the northbound PM peak (see Figure 7), while little variation in travel time reliability was observed in the southbound AM peak.

Figure 7: All Lanes Travel Time Index, PM Peak Period, Northbound



5.1.3 Managed Lane Speed Assessment

The managed lane speed assessment, which tracks the number of peak hours where average speeds were below 45 mph, showed the most improvement at Stone Valley Rd in the northbound PM peak, the location/period that was most deficient in the 2014 Baseline period.

Results of the managed lane speed assessment at Stone Valley Rd are shown in Table 11.

Table 11: Summary of Managed Lane Speed Assessment at Stone Valley Road

Performance Measure	Peak Period, Peak Direction	2014 Baseline	2017 Baseline	After Period (2018)
Managed Lane Speed Assessment @ Stone Valley Rd	AM + PM Peak (SB) AM + PM Peak (NB)	12 hours 296 hours	NA	**39 hours** **168 hours**

Legend: GREEN for improvement, YELLOW for minor variation, RED for worsening, BLACK for mixed trends

In the northbound direction during the PM peak, there were two locations where managed lane speeds of less than 45 mph were reported for more than 10 percent of peak period hours in the 2014 Baseline and After conditions (see Table 12). The northernmost of these locations at Stone Valley Road, which experiences the most significant congestion in the corridor, saw a reduction in the number of peak period hours experiencing speeds below 45 mph in the After condition, indicating greater reliability of managed lane speeds after express lane implementation

The southbound direction experienced minor increases in the duration of the peak period that had speeds below 45 mph, when compared to the 2014 Baseline period.

Table 12: Managed Lane Speed Assessment – Percentage of Deficient Hours

Location	2014 Baseline Period Percent of Hours < 45 mph	2018 After Period Percent of Hours < 45 mph
	Northbound	
Greenbrook Drive	13%	17%
Stone Valley Road	30%	17%
	Southbound	
Stone Valley Road	1%	4%

5.2 Delay Trends

Delay trends include measures that report on congestion and corresponding delays, and level of service at key locations along the corridor.

5.2.1 Bottlenecks, Queues, and Duration

Queueing was observed in the 2017 Baseline and After periods in the northbound PM peak; although the location of the queue and the queue length shifted, the duration of the queue was shortened. No significant changes in queueing were observed in the general purpose lanes.

A summary of observable bottlenecks and queue lengths in the HOV/express lanes is provided in Table 13, with general purpose lanes summarized in Table 14.

Table 13: Summary of Congestion Trends (HOV/Express Lanes)

Performance Measure	Peak Period, Peak Direction	2014 Baseline	2017 Baseline	After Period (2018)
Queue Lengths and Duration	AM Peak (SB)	None	None	0.7 miles 0.5 hours
	PM Peak (NB)	7 miles 2 hours (Crow Canyon - Livorna)	2.4 miles 2 hours (Sycamore – El Pintado)	3.4 miles 1 hour (El Cerro – Livorna)

Legend: GREEN for improvement, YELLOW for minor variation, RED for worsening, BLACK for mixed trends

Table 14: Summary of Congestion Trends (General Purpose Lanes)

Performance Measure	Peak Period, Peak Direction	2014 Baseline	2017 Baseline	After Period (2018)
Queue Lengths and Duration	AM Peak (SB)	2.7 miles 2 hours (S. Main to Stone Valley)	3.3 miles 3 hours (S. Main to Stone Valley)	2.7 miles 3 hours (S. Main to Stone Valley)
	PM Peak (NB)	8.5 miles 3 hours (Crow Canyon - Livorna)	7.2 miles 3 hours (Sycamore Valley - S. Main)	6.7 miles 3 hours (Sycamore Valley - S. Main)

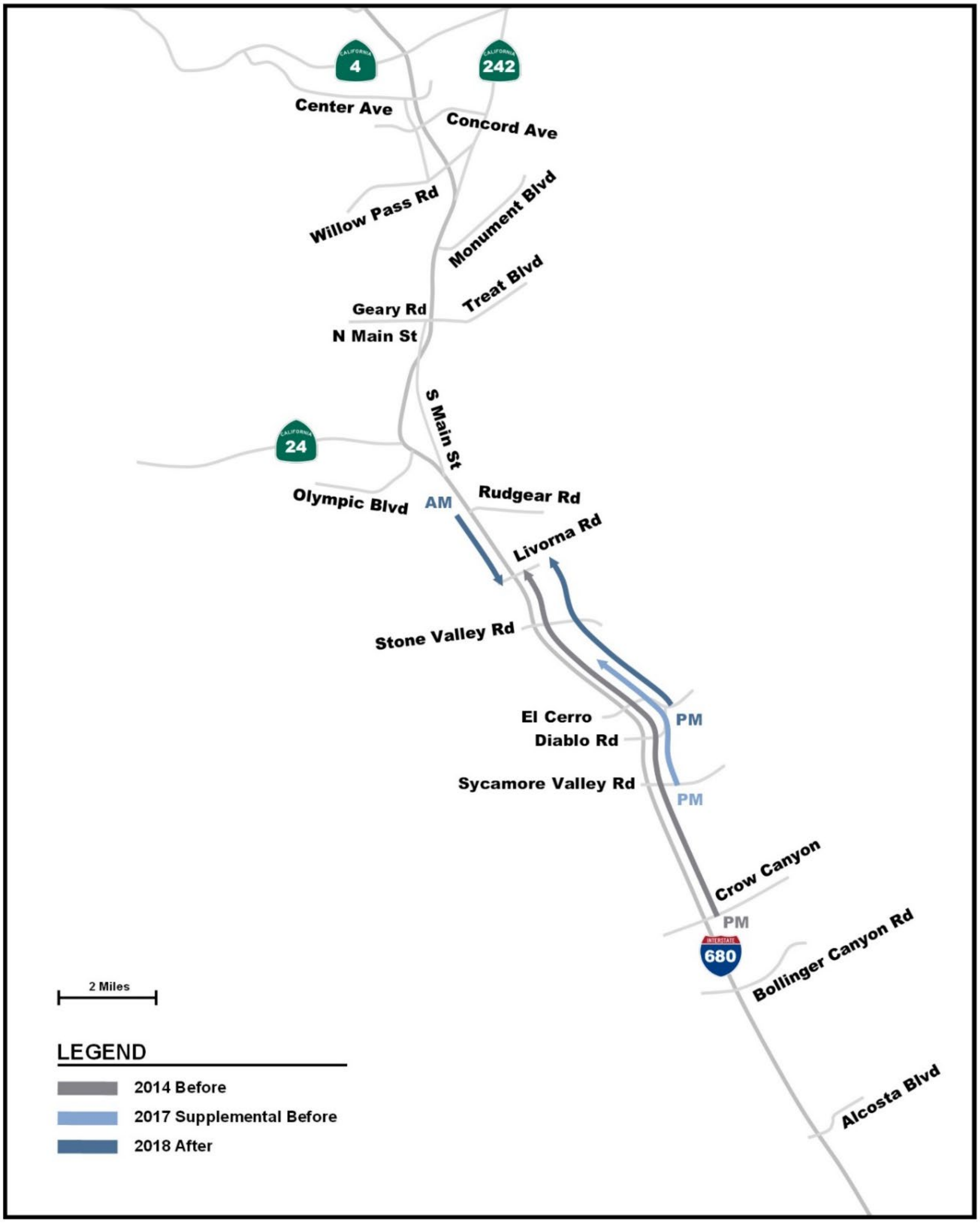
Legend: GREEN for improvement, YELLOW for minor variation, RED for worsening, BLACK for mixed trends

HOV/Express Lanes

In the northbound direction during the PM peak, the queue in the northern part of the corridor was observed to shift northward and to extend in length (Figure 8); however, the duration of the queue decreased by 1 hour after implementation of the express lanes. The northbound queueing is attributable to a bottleneck located downstream of the terminus of the express lane that causes traffic queueing to spill back into the express lane. Congestion in the express lane is also attributable to friction from congested operations in the adjacent general purpose lanes.

A moderate level of queueing in the southbound direction during the AM peak was observed to form in the After conditions between Rudgear Rd and Livorna Rd. This queue was only observed during the peak 30 minutes of the AM peak period and may be attributable to an increase in vehicle volumes, which were observed to increase by 28 percent when compared to the 2014 Baseline period.

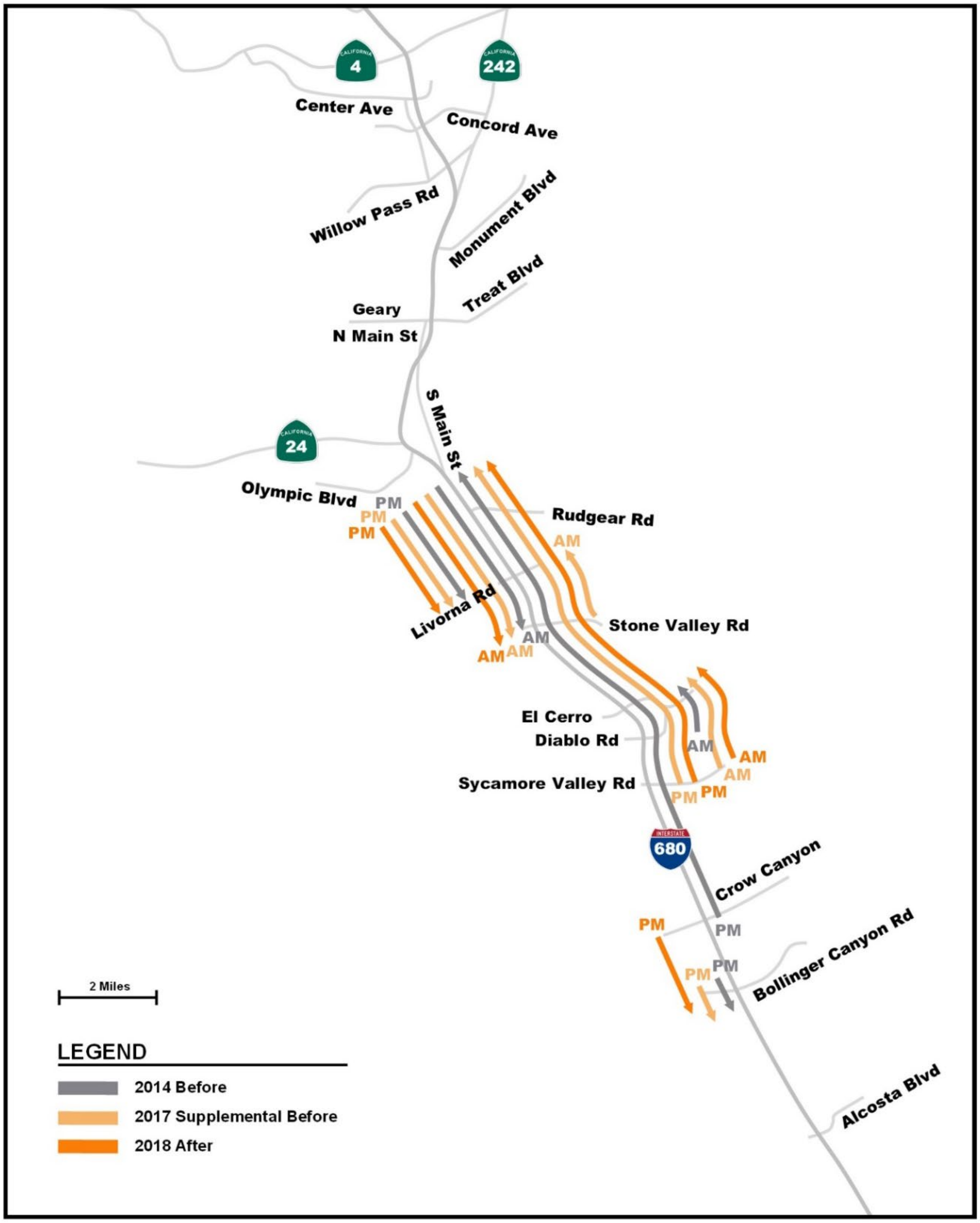
Figure 8: Managed Lane Queues



General Purpose Lanes

No significant change in queueing was observed in the general purpose lanes after the express lanes conversion as shown in Figure 9.

Figure 9: General Purpose Lane Queues



5.2.2 Delay

Managed lane delays decreased for the most congested conditions in the northbound PM peak period while all other directions and periods experienced minor variation when compared to the Baseline conditions.

Delay was measured and compared in two ways. The first delay metric shown below in Table 15 measures the difference between observed travel times and free-flow travel times. The second metric, vehicle-hours of delay, factors in vehicle volumes to represent the total amount of delay experienced by vehicles within the respective peak periods.

A summary of delay trends in the HOV/express lanes is provided in Table 15, with general purpose lanes summarized in Table 16.

Table 15: Summary of Delay Trends (HOV/Express Lanes)

Performance Measure	Peak Period, Peak Direction	2014 Baseline	2017 Baseline	After Period (2018)
Delay	AM Peak (SB) PM Peak (NB)	1.4 min (max) 9.3 min (max)	1.3 min (max) 4.2 min (max)	1.4 min **(max)** 3.2 min **(max)**
Vehicle-Hours of Delay (VHD)	AM Peak (SB) PM Peak (NB)	44 hours 393 hours	NA	**55 hours** **103 hours**

Legend: GREEN for improvement, YELLOW for minor variation, RED for worsening, BLACK for mixed trends

Table 16: Summary of Delay Trends (General Purpose Lanes)

Performance Measure	Peak Period, Peak Direction	2014 Baseline	2017 Baseline	After Period (2018)
Delay	AM Peak (SB) PM Peak (NB)	4.1 min (max) 16.6 min (max)	4.9 min (max) 7.4 min (max)	3.9 min **(max)** 7.9 min **(max)**
Vehicle-Hours of Delay (VHD)	AM Peak (SB) PM Peak (NB)	431 hours 249 hours	NA	**431 hours** **438 hours**

Legend: GREEN for improvement, YELLOW for minor variation, RED for worsening, BLACK for mixed trends

HOV/Express Lanes

The most notable improvements in delay were experienced in the northbound PM peak period. The maximum observed delays dropped by one minute when comparing the 2017 Baseline to the After Period. Vehicle-hours of delay also dropped when comparing the 2014 Baseline to the After Period; however, this drop does not account for overall improvements in delay that were experienced before the express lanes were opened and therefore cannot be entirely attributed to the express lane conversion.

In the southbound AM peak, maximum observed delays showed minor variation from the 2017 Baseline. Vehicle-hours of delay increased slightly when compared to the 2014 Baseline, which is largely attributable to an increase in vehicle throughput in the southbound direction during the AM peak.

General Purpose Lanes

General purpose lane delays remained similar to the 2017 Baseline conditions for the northbound PM peak and southbound AM peak periods.

5.2.3 Level of Service

LOS in the express lanes improved in the northbound PM peak in the most congested segment of the corridor when compared to 2014 Baseline conditions. In the southbound AM peak at the same location, the duration of LOS D conditions was observed to increase. Similar patterns were observed for the general purpose lanes.

The most degraded LOS measurements at the most congested survey location, Stone Valley Road, are shown below in Table 17 for the HOV/express lanes and in Table 18 for the general purpose lanes.

Table 17: Summary of Level of Service Measurements (HOV/Express Lanes)

Performance Measure	Peak Period, Peak Direction	2014 Baseline	2017 Baseline	After Period (2018)
Level of Service (LOS) @ Stone Valley Rd	AM Peak (SB) PM Peak (NB)	LOS D (1 hour) LOS F (1 hour)	NA	**LOS D (3 hours)** **LOS E (1 hour)**

Legend: GREEN for improvement, YELLOW for minor variation, RED for worsening, BLACK for mixed trends

Table 18: Summary of Level of Service Measurements (General Purpose Lanes)

Performance Measure	Peak Period, Peak Direction	2014 Baseline	2017 Baseline	After Period (2018)
Level of Service (LOS) @ Stone Valley Rd	AM Peak (SB) PM Peak (NB)	LOS E (2 hours) LOS F (3 hours)	NA	**LOS E (3 hours)** **LOS F (1 hour)**

Legend: GREEN for improvement, YELLOW for minor variation, RED for worsening, BLACK for mixed trends

HOV/Express Lanes

The express lane LOS experienced the most improvement northbound approaching Greenbrook Drive and Stone Valley Road. The LOS at Stone Valley Road improved from LOS F (1 hour) to LOS E (1 hour).

In the southbound direction at Stone Valley Road, the duration of LOS D conditions increased from one hour in the 2014 Baseline to three hours in the After period.

General Purpose Lanes

Similar to the express lanes, LOS in the northbound PM peak experienced notable improvement approaching Greenbrook Drive and Stone Valley Road. The LOS at Stone Valley Road improved from LOS F (3 hours) to LOS F (1 hour).

Similar to the trend observed for the express lanes, the duration of LOS E conditions at Stone Valley Road in the southbound AM peak increased from two hours to three hours.

5.3 Utilization Trends

Utilization trends include measures that report on vehicle occupancy levels, vehicle and person throughput, and occupancy violations in the corridor. Vehicle occupancy and throughput data was not collected in 2017, so these results are compared to 2014 Baseline conditions.

5.3.1 Vehicle Occupancy and Classification

Decreases in average vehicle occupancy, when compared to 2014 Baseline conditions, were observed after the conversion to express lanes, reflecting the increases in single occupant vehicles using the lanes.

Average vehicle occupancy results for the HOV/express lanes are presented in Table 19, with general purpose lanes summarized in Table 20.

Table 19: Summary of Vehicle Occupancy Trends (HOV/Express Lanes)

Performance Measure	Peak Period, Peak Direction	2014 Baseline	2017 Baseline	After Period (2018)
Vehicle Occupancy; Classification @ Greenbrook Dr	AM Peak (SB)	2.23 occ 23% SOV 76% HOV	NA	1.65 occ 58% SOV 42% HOV
	PM Peak (NB)	2.11 occ 20% SOV 79% HOV		1.76 occ 63% SOV 41% HOV

Table 20: Summary of Vehicle Occupancy Trends (General Purpose Lanes)

Performance Measure	Peak Period, Peak Direction	2014 Baseline	2017 Baseline	After Period (2018)
Vehicle Occupancy; Classification @ Greenbrook Dr	AM Peak (SB)	1.24 occ 89% SOV 6% HOV	NA	1.17 occ 90% SOV 6% HOV
	PM Peak (NB)	1.15 occ 91% SOV 5% HOV		1.24 occ 85% SOV 10% HOV

HOV/Express Lanes

Allowing single occupant vehicles to use the available capacity in the express lanes has the effect of decreasing the average vehicle occupancy as well as decreasing the proportion of HOVs in the express lanes. For both peak periods and directions, the average vehicle occupancies in the express lane decreased when compared to 2014 Baseline conditions. Prior to implementation of the express lanes, average vehicle occupancies in the HOV lane were greater than 1.9 persons per vehicle at all survey locations. This decreased to less than 1.8 persons per vehicle with the conversion to express lanes. The number of HOV eligible vehicles as a percentage of the overall traffic volume also dropped as a result of there being more single occupant vehicles in the express lanes.

General Purpose Lanes

For both peak periods and directions, average vehicle occupancies in the GP lane experienced minor increases when compared to 2014 Baseline conditions.

5.3.2 Vehicle Throughput

> ***Vehicle throughput was generally observed to decrease in the express lane and general purpose lanes in the northbound PM peak, with the exception of one survey location. In the southbound AM peak, vehicle throughput was observed to increase in the express lane despite vehicle throughput decreasing in the general purpose lanes.***

Vehicle throughput measured across all lanes (express lanes and general purpose lanes) at various locations along the corridor is shown in Table 21 below.

Table 21: Vehicle Throughput (All Lanes)

Peak Period, Peak Direction	Survey Location	2014 Baseline	2017 Baseline	After Period (2018)
AM Peak (SB) (all lanes)	Sycamore Valley Rd	12,180 veh	NA	11,760 veh
	Greenbrook Dr	9,720 veh	NA	9,670 veh
	Norris Canyon Rd	11,900 veh	NA	11,960 veh
PM Peak (NB) (all lanes)	Greenbrook Dr	10,300 veh	NA	11,640 veh
	Crow Canyon Rd	9,920 veh	NA	8,920 veh
	Bollinger Canyon Rd	9,600 veh	NA	8,750 veh
	Alcosta Blvd	10,920 veh	NA	8,570 veh

In the northbound PM peak, vehicle throughput increased at the northernmost survey location (Greenbrook Dr) but decreased at all other survey locations. This matches the trend observed for vehicle throughput in the general purpose lanes, which would indicate that the traffic volume decreases observed in the express lane are a result of a global decrease in traffic volume across all lanes in the northbound PM peak period.

For the southbound AM peak, vehicle throughput in the express lane was observed to increase at all survey locations while throughput in the general purpose lanes was observed to decrease.

While vehicle throughput was generally observed to decrease across all freeway lanes when compared to 2014 Baseline conditions, this trend is not thought to be directly attributable to the implementation of the express lanes. As noted at the beginning of Section 5, overall improvements were observed for many of the performance measures when comparing 2014 to 2017 data. These included improvements in travel time, travel time reliability, queue lengths and travel delay. All of these improvements would be consistent with a drop in vehicle volumes and throughput. Therefore, the observed decrease in vehicle throughput between 2014 and 2018 is likely related to the trend observed before the express lanes opened.

5.3.3 Person Throughput

Person throughput was generally observed to decrease across most survey locations in the express lanes and the general purpose lanes in the northbound PM peak and southbound PM peak periods.

Person throughput measured across all freeway lanes is shown in Table 22 below.

Table 22: Person Throughput (All Lanes)

Peak Period, Peak Direction	Survey Location	2014 Baseline	2017 Baseline	After Period (2018)
AM Peak (SB) (all lanes)	Sycamore Valley Rd	15,150 persons	NA	15,040 persons
	Greenbrook Dr	13,280 persons	NA	12,060 persons
	Norris Canyon Rd	14,910 persons	NA	15,000 persons
PM Peak (NB) (all lanes)	Greenbrook Dr	13,900 persons	NA	15,660 persons
	Crow Canyon Rd	13,660 persons	NA	12,140 persons
	Bollinger Canyon Rd	12,490 persons	NA	10,890 persons
	Alcosta Blvd	14,120 persons	NA	10,480 persons

Trends in person throughput matched those observed for vehicle throughput. In the northbound PM peak, person throughput decreased at all locations, except for the northernmost survey location at Greenbrook Dr where person throughput increased. Person throughput in the southbound AM peak decreased at all locations except for the southernmost survey location at Norris Canyon Road. The locations where person throughput was observed to increase are the same locations where vehicle throughput was observed to increase, highlighting that person throughput is correlated with vehicle throughput.

5.3.4 Violations

Violation rates collected after the implementation of the express lanes were estimated to be between 4-8% in the northbound direction and between 1-5% in the southbound direction.

Table 23: Estimated Violations (HOV/Express Lanes)

Peak Period, Peak Direction	Survey Location	2014 Baseline	2017 Baseline	After Period (2018)
AM Peak (SB)	Alcosta Blvd	NA	NA	4%
	Crow Canyon Rd	NA	NA	5%
PM Peak (NB)	Crow Canyon Rd	NA	NA	7%
	Livorna Rd	NA	NA	6%

Although true express lane violation rates are difficult to measure, an estimate of the number of violators (i.e., those declaring to be a carpool but only having a single occupant) was estimated by comparing observed vehicle counts with the data collected by the toll system during the same period.

Toll tag data collected during 4-hour AM and PM peak periods was compared to manual occupancy counts collected during the same as a way to estimate the incidence of carpool violations. The northbound express lanes experienced a higher number of estimated violations, with a range of four to eight percent of total express lane volume, than the southbound direction, which ranged from one to five percent of total express lane volume. Given the uncertainty in the methodology used to estimate these rates, it is assumed that the true violation rate could differ significantly from the results shown.

6. CONCLUSIONS

Overall, the results of the study indicate moderate improvements in the express lane in the most congested peak direction (northbound PM peak) when compared to baseline conditions. Results for the express lane in the opposite peak direction (southbound AM peak) show little variation from baseline conditions. Furthermore, the study did not reveal that the express lanes contributed to any adverse impacts to the general purpose lanes.

Conclusions for each category of performance measure are summarized in the following sections. Refer to Table 24 for the data summary of results for the HOV/express lane, and Table 25 for the general purpose lanes.

6.1 Travel Time Trend Summary

In general, travel times, speeds and reliability improved in the express lane in most congested peak direction, the northbound PM peak. The maximum average travel time was observed to decrease by one minute and minimum average speeds improved from 42 mph to 46 mph when compared to 2017 Baseline conditions. Measures of travel time reliability, including Travel Time Index and Planning Time Index, also showed improvement after the express lane conversion in the northbound PM peak. In the southbound AM peak period, which experiences much less congestion, travel time, speed and reliability measures in the express lane showed little variation compared to 2017 Baseline conditions.

General purpose lane trends were observed to match those observed in the express lanes. In the northbound PM peak, general purpose lane travel times, speeds and reliability were generally observed to improve or remain close to 2017 Baseline conditions. In the southbound AM peak, general purpose lane travel times and speeds experienced a moderate improvement.

6.2 Delay Trend Summary

Results for performance measures associated with delay and congestion generally follow a similar trend for the measures associated with travel time and speeds. In the northbound PM peak in the express lane, when compared to 2017 Baseline conditions, delay was observed to decrease, and LOS improved, when compared to 2014 Baseline conditions. Although queueing was still observed to occur after the express lane conversion, the duration of the queue was shortened from 2 hours to 1 hour. In the southbound AM peak, minor variation was observed with respect to delay, LOS and queueing in the express lane.

Again, delay and congestion trends in the general purpose lanes generally match those observed in the express lanes, when compared to 2017 and 2014 Baseline conditions respectively. There is no evidence to suggest that the express lane implementation was the cause for any change in general purpose lane conditions.

6.3 Utilization Trend Summary

Performance measures related to utilization showed that the conversion to express lanes resulted in a greater share of SOVs in the express lanes, as expected, and a resulting decrease in average vehicle occupancy when measured across all SOVs and HOVs in the express lanes. Vehicle throughput was generally observed to decrease across all freeway lanes when compared to 2014 Baseline conditions. This is not thought to be attributable to the express lane implementation in light of other performance measure improvements that were observed prior to the express lanes opening. The reduction in vehicle throughput resulted in an overall decrease in person throughput across all lanes.

Table 24: Managed Lanes, Summary of Performance Measures

Performance Measure	Peak Period, Peak Direction	2014 Baseline	2017 Baseline	After Period (2018)
Travel Time				
Travel Times; Speeds	AM Peak (SB)	9.8 min (max) (3.6 min savings); 56 mph (min)	9.7 min (max) (4.2 min savings); 57 mph (min)	**9.8 min (max) (3.6 min savings); 57 mph (min)**
	PM Peak (NB)	16.9 min (max) (8.9 min savings); 30 mph (min)	11.9 min (max) (3.8 min savings); 42 mph (min)	**10.9 min (max) (6.0 min savings); 46 mph (min)**
Travel Time Reliability (all lanes)	AM Peak (SB)	1.46 TTI (max) 1.96 PTI (max)	1.53 TTI (max) 1.80 PTI (max)	**1.43 TTI (max) 1.71 PTI (max)**
	PM Peak (NB)	2.26 TTI (max) 3.85 PTI (max)	2.06 TTI (max) 3.32 PTI (max)	**1.87 TTI (max) 2.58 PTI (max)**
Managed Lane Speed Assessment @ Stone Valley Rd	AM + PM Peak (SB) AM + PM Peak (NB)	12 hours 296 hours	NA	**39 hours** **168 hours**

Table 24: Managed Lanes, Summary of Performance Measures

Performance Measure	Peak Period, Peak Direction	2014 Baseline	2017 Baseline	After Period (2018)
Delay				
Queue Lengths and Duration	AM Peak (SB) PM Peak (NB)	None 7 miles 2 hours (Crow Canyon - Livorna)	None 2.4 miles 2 hours (Sycamore – El Pintado)	0.7 miles 0.5 hours 3.4 miles 1 hour (El Cerro - Livorna)
Delay	AM Peak (SB) PM Peak (NB)	1.4 min (max) 9.3 min (max)	1.3 min (max) 4.2 min (max)	1.4 min **(max)** 3.2 min **(max)**
Vehicle-Hours of Delay (VHD)	AM Peak (SB) PM Peak (NB)	44 hours 393 hours	NA	55 hours 103 hours
Level of Service (LOS) @ Stone Valley Rd	AM Peak (SB) PM Peak (NB)	LOS D (1 hour) LOS F (1 hour)	NA	LOS D (3 hours) LOS E (1 hour)
Utilization				
Vehicle Occupancy; Classification @ Greenbrook Dr	AM Peak (SB) PM Peak (NB)	2.23 occ 23% SOV 76% HOV 2.11 occ 20% SOV 79% HOV	NA	1.65 occ 58% SOV 42% HOV 1.76 occ 63% SOV 41% HOV
Vehicle/Person Throughput	AM Peak (SB) @ Greenbrook Dr PM Peak (NB) @ Crow Canyon Rd	1,280 veh 2,850 persons 2,160 veh 4,560 persons	NA	1,640 veh 2,700 persons 2,400 veh 4,230 persons
Violations @ Crow Canyon Rd	AM Peak (SB) PM Peak (NB	NA	NA	5% 7%

Legend: **GREEN** for improvement, **YELLOW** for minor variation, **RED** for worsening, **BLACK** for mixed trends

Table 25: General Purpose Lanes, Summary of Performance Measures

Performance Measure	Peak Period, Peak Direction	2014 Baseline	2017 Baseline	After Period (2018)
Travel Time				
Travel Times; Speeds	AM Peak (SB)	12.5 min (max) 43 mph (min)	13.3 min (max) 41 mph (min)	12.3 min **(max)** 44 mph **(min)**
	PM Peak (NB)	24.2 min (max) 20 mph (min)	15.1 min (max) 31 mph (min)	15.6 min **(max)** 31 mph **(min)**
Travel Time Reliability (all lanes)	AM Peak (SB)	1.46 TTI (max) 1.96 PTI (max)	1.53 TTI (max) 1.80 PTI (max)	1.43 TTI **(max)** 1.71 PTI **(max)**
	PM Peak (NB)	2.26 TTI (max) 3.85 PTI (max)	2.06 TTI (max) 3.32 PTI (max)	1.87 TTI **(max)** 2.58 PTI **(max)**
Delay				
Queue lengths and duration	AM Peak (SB)	2.7 miles 2 hours (S. Main to Stone Valley)	3.3 miles 3 hours (S. Main to Stone Valley)	2.7 miles 3 hours (S. Main to Stone Valley)
	PM Peak (NB)	8.5 miles 3 hours (Crow Canyon - Livorna)	7.2 miles 3 hours (Sycamore Valley - S. Main)	6.7 miles 3 hours (Sycamore Valley - S. Main)
Delay	AM Peak (SB) PM Peak (NB)	4.1 min (max) 16.6 min (max)	4.9 min (max) 7.4 min (max)	3.9 min **(max)** 7.9 min **(max)**
Vehicle-Hours of Delay (VHD)	AM Peak (SB) PM Peak (NB)	431 hours 249 hours	NA	431 hours 438 hours
Level of Service (LOS) @ Stone Valley Rd	AM Peak (SB) PM Peak (NB)	LOS E (2 hours) LOS F (3 hours)	NA	LOS E (3 hours) LOS F (1 hour)

Table 25: General Purpose Lanes, Summary of Performance Measures

Performance Measure	Peak Period, Peak Direction	2014 Baseline	2017 Baseline	After Period (2018)
Utilization				
Vehicle Occupancy; Classification @ Greenbrook Dr	AM Peak (SB) PM Peak (NB)	1.24 occ 89% SOV 6% HOV 1.15 occ 91% SOV 5% HOV	NA	1.17 occ 90% SOV 6% HOV 1.24 occ 85% SOV 10% HOV
Vehicle/Person Throughput	AM Peak (SB) @ Greenbrook Dr PM Peak (NB) @ Crow Canyon Rd	8,440 veh 10,430 persons 8,070 veh 9,660 persons	NA	8,030 veh 9,360 persons 7,350 veh 9,440 persons

Legend: **GREEN** for improvement, **YELLOW** for minor variation, **RED** for worsening, **BLACK** for mixed trends

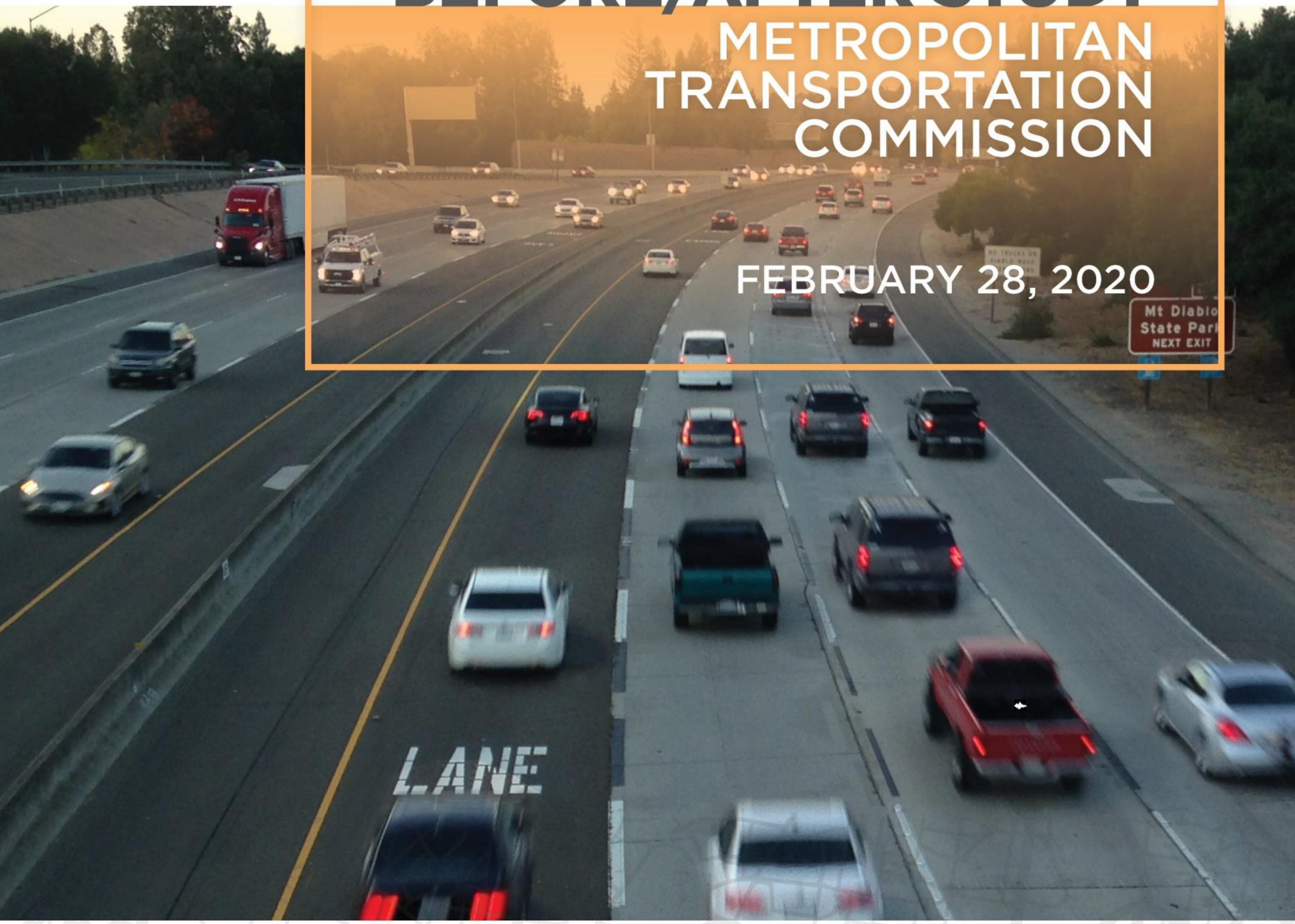
Appendix A

FINAL REPORT

CONTRA COSTA I-680 EXPRESS LANES BEFORE/AFTER STUDY

METROPOLITAN TRANSPORTATION COMMISSION

FEBRUARY 28, 2020



KITTELSON & ASSOCIATES

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1. SUMMARY

The operations of the Interstate 680 (I-680) freeway corridor in Contra Costa County were documented prior to the conversion of the existing northbound and southbound high-occupancy vehicle (HOV) lanes to express lanes. These "Before" conditions are compared to operations after the implementation of the express lanes in order to evaluate the impacts of the express lanes on the performance of the corridor.

IN THIS REPORT>>

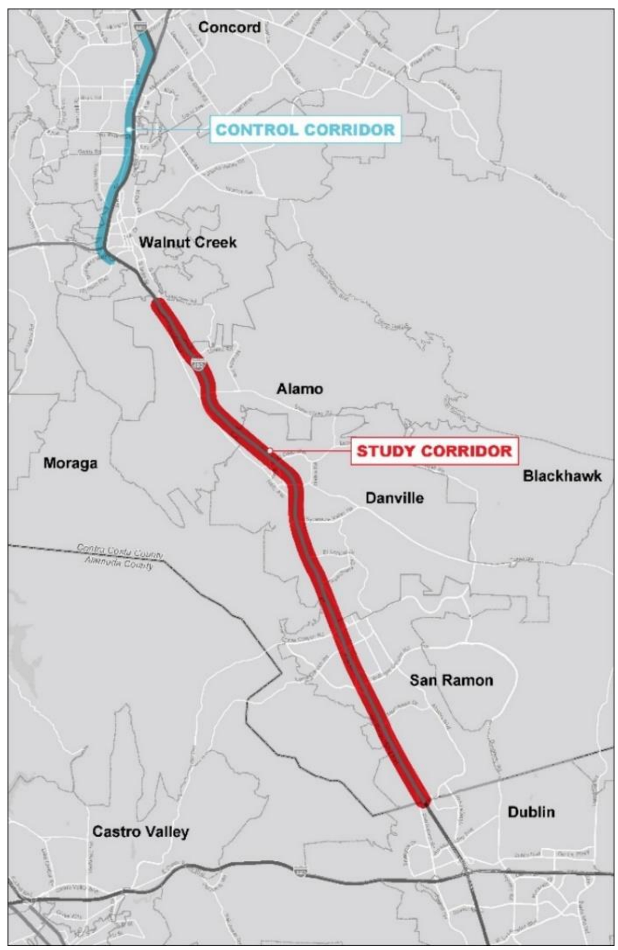
- Data collected
- Methodoologies
- Evaluation based on performance measures

The study corridor is defined as northbound and southbound I-680 between Alcosta Boulevard and Rudgear Road. A control corridor, southbound I-680 between Willow Pass Road and Olympic Boulevard, was also evaluated to help identify changes in travel characteristics not related to express lane implementation.

1.1. PERFORMANCE MEASURES

Eleven performance measures were identified to evaluate the operations of the I-680 corridor before and after the implementation of express lanes.

Performance Measures	
1	Travel Time and Speed
2	Delay
3	Bottlenecks, Maximum Queue Length and Duration of Congestion
4	Vehicle Occupancy and Classification
5	Vehicle Throughput
6	Person Throughput
7	Vehicle-Hours of Delay (VHD)
8	Level of Service (LOS)
9	Travel Time Reliability
10	Managed Lane Speed Assessment
11	Violations



1.2. DATA COLLECTION

New data collection was conducted for the "Before" study in 2014, a "Supplemental Before" study in 2017, and the "After" study in 2018.

Incidents were monitored during data collection, and data were excluded from time periods where traffic flow was affected by incidents. Additional checks and screening criteria were used to identify the data that would be appropriate to include in the evaluation.

Data Collection
New Data Collection
Travel time surveys using "floating car" runs
Manual counts of vehicle classification and **occupancy** at 7 locations
Automated **traffic counts** using radar detectors at 3 locations
Visual observations with video recordings
Available Data
Traffic counts and speeds from **PeMS** (Caltrans Freeway Performance Measurement System)
INRIX travel times based on mobile source (cell phones, GPS) data
Express lane toll tag detectors

1.3. STUDY CORRIDOR RESULTS

Key findings for the I-680 study corridor performance measures are listed below, comparing the 2018 After conditions with the 2014 Before and 2017 Supplemental Before conditions.

Travel Times

MEASURES 1,2>>

Travel times improved for the most congested conditions.

Travel times in the express lanes improved in the most congested conditions, northbound during the PM peak period, compared to the travel times in the HOV lane in the 2014 Before and 2017 Supplemental Before studies. In the general purpose lanes, the maximum northbound PM travel times decreased significantly between the 2014 Before study and the 2017 Supplemental Before study, and then remained at similar times for the 2018 After study.

Travel times remained constant for less congested conditions.

Travel times in both directions during the AM peak period and southbound during the PM peak period stayed relatively constant after the implementation of express lanes, for both the managed lanes and the general purpose lanes.

Speeds

MEASURE 1>>

Speeds improved for the most congested conditions.

Managed lane speeds in the PM peak period improved significantly in the northbound direction. During the Before study surveys, speeds below 35 mph were observed in the HOV lane for 1.5 hours. The average speeds in the northbound express lane in the After study were higher than 45 mph throughout the PM peak period. Speeds also improved in the general purpose lanes after implementation of the express lanes, from over two hours at less than 35 mph and minimum speeds of 20 mph in the Before conditions to just one-half hour less than 35 mph in the After conditions.

In the AM peak period, both directions, and the PM peak period southbound direction, there were few differences in speeds between the Before and After conditions.

Queues and Duration of Congestion

MEASURE 3>>

The major queue in the HOV lane reduced significantly in the express lane.

In the northbound PM peak period, a 7-mile HOV lane queue from Livorna Road lasting 2 hours in the Before study decreased to a 3.4-mile express lane queue lasting 1 hour in the After study. Some additional queue conditions were observed in the After conditions for the AM peak period southbound at Livorna Road.

General purpose lane queues were similar after implementation of the express lanes.

The implementation of the express lanes did not appear to significantly shorten or lengthen queues in the general purpose lanes. Significant queues remained southbound in the AM peak period at Livorna Road and northbound in the PM peak period from Danville to Walnut Creek.

Vehicle Occupancy

MEASURE 4>>

Managed lane average vehicle occupancies decreased.

In all locations, the average vehicle occupancies (AVO) in the HOV/Express lane decreased from values of 1.9 or more in the HOV lane to values of less than 1.8 after implementation of the express lane.

Changes in total corridor average vehicle occupancies varied by location.

The total AVO for all lanes increased at one of seven survey location, stayed constant at two locations, and decreased at four locations during both the AM and PM peak periods.

Throughput

MEASURES 5,6>>

Throughput increased for the most congested conditions.

In the most congested survey location, northbound at Greenbrook Drive during the PM peak period, vehicle and person throughput both increased by 13 percent after the implementation of express lanes.

Throughput changes varied by time period.

The total vehicle throughput for the four-hour peak periods at all seven locations combined results in a 1.7 percent increase in total volume for the AM peak period and a 0.9 percent reduction in total volume in the PM peak period.

The total person throughput for the two-hour peak periods at all seven survey locations combined results in a 1.4 percent increase in total person throughput for the AM peak period and a 3.8 percent reduction in total person throughput in the PM peak period.

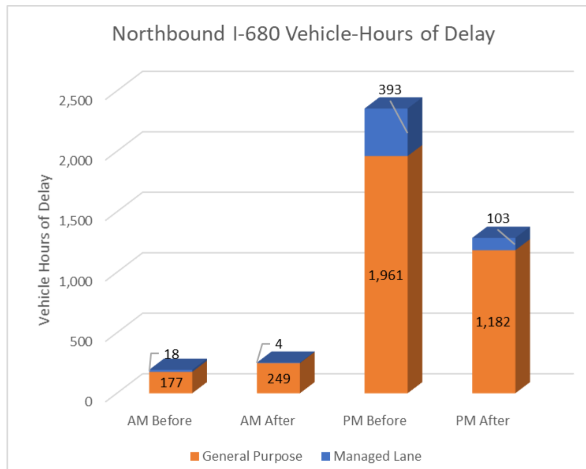
The reduction in the PM peak period throughput could be related to changes in economic activity in the study corridor, such as employment levels at major Bishop Ranch employers, but do not appear to be related to freeway operating conditions as the decreases occurred in relatively uncongested segments.

Vehicle-Hours of Delay

MEASURES 7,8>>

There were significant decreases in total peak period vehicle-hours of delay.

There was a reduction of 62 percent in total (AM+PM) peak period VHD in the HOV/Express lanes, an 18 percent reduction in the general purpose lanes, and a 25 percent overall reduction in peak period delay.



Level of Service

Level of service generally improved.

Freeway level of service generally improved after the implementation of express lanes for both the HOV/Express lanes and the general purpose lanes.

Travel Time Reliability

MEASURE 9>>

Reliability improved for the most congested conditions.

Overall corridor (all lanes) travel time reliability improved for the most congested conditions, northbound during the PM peak period, after the implementation of express lanes. The express lane implementation did not have a consistent effect on reliability measures during the AM peak period or southbound during the PM peak period.

During most hours of the PM peak period, the HOV/Express lane reliability improved in the After conditions.

Managed Lane Speed Assessment

MEASURE 10>>

Express lane speed reliability improved at the most congested location.

The managed lane speed assessment after the implementation of the Express lane improved significantly at the location that was most deficient in the Before conditions, from 30 percent of hours less than 45 mph to 17 percent of hours less than 45 mph.

Violations

MEASURE 11>>

Maximum toll violations were estimated at 8 percent of express lane vehicles.

The maximum estimated violations, defined as the number of single-occupant vehicles (SOV) in the express lane based on manual counts exceeding the number of SOVs recorded by the toll system for the same time period, were in the northbound direction during the PM peak period. The violation rates were estimated as 10 to 13 percent of SOVs or 6 to 8 percent of total express lane volume. AM peak violation rates were 6 to 8 percent of SOVs or 4 to 5 percent of total express lane volume. Few violations were estimated southbound in the PM peak period.

1.4. CONTROL CORRIDOR RESULTS

Selected performance measures were compiled for the control corridor, I-680 southbound from Willow Pass Road to Olympic Boulevard. These results were compared to the study corridor to help determine if changes on the study corridor were consistent with regional traffic trends.

Maximum travel times improved on the control corridor.

In the 2014 Before study, travel times on the I-680 control corridor during the AM peak period varied from 5.2 minutes up to a maximum of 19.8 minutes. In the After study, the maximum travel time was reduced to 15.9 minutes, a reduction of 20 percent. There were no significant changes in travel times or speeds during the PM peak period.

Queues have remained constant on the control corridor.

The I-680 control corridor had a queue of approximately 4 miles that lasted 3 to 3.5 hours during the 2014 Before, 2017 Supplemental Before, and After studies. No queues were observed during the PM peak period.

Vehicle occupancies have remained constant on the control corridor.

The overall average vehicle occupancy (AVO) for all lanes decreased by 2 percent in the AM peak period and increased by 4 percent in the PM peak period. Therefore, there was no consistent trend of increased or decreased high-occupancy vehicle usage in the control corridor. Vehicle classifications for all lanes stayed relatively constant between the Before and After studies.

Throughput increased in the control corridor.

Total vehicle throughput in all lanes increased by 12 percent in the AM peak period and by 9 percent in the PM peak period. Total person throughput in all lanes increased by 10 percent in the AM peak period and 5 percent in the PM peak period. This could indicate that general travel demand was increasing between the Before and After periods, which is inconsistent with some of the reductions in throughput observed in the southern portions of the study corridor.

Reliability improved on the control corridor.

Travel time reliability on the control corridor was worse than the study corridor in the Before study, with 95th percentile travel times up to five times the free-flow travel times during the AM peak period. The After study reliability measures generally improved compared to the Before and Supplemental Before conditions.

1.5. CONCLUSIONS

- I-680 study corridor traffic operations (travel times, speeds, reliability) on both managed lanes and general purpose lanes generally either improved or remained constant after the implementation of express lanes. Operations on the I-680 control corridor also improved during the same time frame.

- Average vehicle occupancies (AVO) decreased at more locations than they increased after implementation of express lanes. The control corridor had no consistent trend of increases or decreases in AVO or SOV percentages.

- Vehicle and person throughput increased in the AM peak period and decreased in the PM peak period. However, throughput increased in the most congested conditions on the study corridor. Both vehicle and person throughput increased on the control corridor. The decrease of vehicle demand during the PM peak period does not appear to be related to general traffic trends or operating conditions on the study corridor, but could be caused by very local economic conditions.

- Total vehicle-hours of delay during peak periods were significantly reduced after implementation of the express lanes.

- For the most congested conditions, northbound during the PM peak period, operating conditions improved while throughput increased after the implementation of the express lanes. Operating conditions for less congested conditions, during the AM peak period and southbound during the PM peak period, were generally similar before and after the implementation of the express lanes.

2. INTRODUCTION

The Bay Area Infrastructure Financing Authority's (BAIFA) first express lanes have been implemented on Interstate 680 (I-680) in Contra Costa County (Figure 1). The "I-680 Southern Segment" converted high-occupancy vehicle (HOV) lanes to express lanes starting on October 9, 2017. In the northbound direction, the express lane operates from Alcosta Boulevard to Livorna Road and is 10.9 miles long. In the southbound direction, the express lane operates from Rudgear Road to Alcosta Boulevard, a distance of 12.6 miles.

IN THIS SECTION>>

- Study purpose
- Study corridor
- Control corridor

2.1. PURPOSE OF THE STUDY

The purpose of this study is to measure system performance and to fulfill statutorily required performance reporting. The three statutes that require express lane performance reporting are:

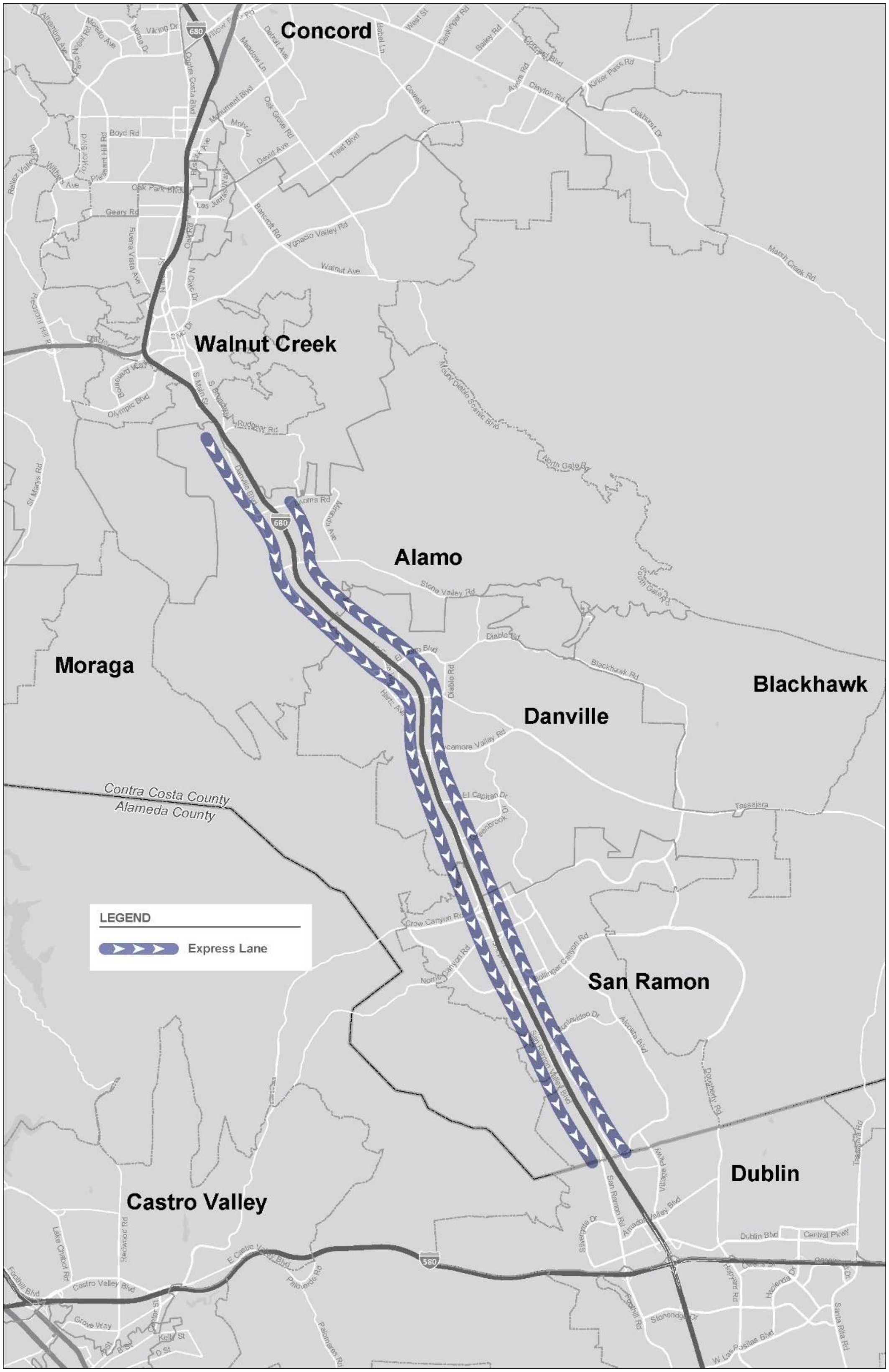
- Section 149.5 of the California Streets & Highways (S&H) Code requires a report to the California Legislature no later than three years after the express lanes begin revenue operations. The language from the S&H Code currently reads as follows:

  Not later than three years after the administering agency first collects revenues from the program authorized by this section, the administering agency shall submit a report to the Legislature on its findings, conclusions, and recommendations concerning the demonstration program authorized by this section. The report shall include an analysis of the effect of the HOT lanes on the adjacent mixed-flow lanes and any comments submitted by the department and the Department of the California Highway Patrol regarding operation of the lane.

- Section 149.7 of the S&H Code requires that the California Transportation Commission (CTC) submit an annual report to the Legislature. MTC staff have been submitting annual reports on the progress of development of the express lane network to the CTC and will incorporate data from the Before and After Study into this report.
- Section 166 of Title 23 of the U.S. Code requires submittal of an annual report to the Secretary of Transportation to document express lane operations impact where HOV lanes have been converted to express lanes. Data from the Before and After Study will be used to support the submittal of this annual report.

A "Before" study was required to establish a benchmark for the operation of the existing general purpose lanes and HOV lanes on I-680 prior to implementation of the express lanes. The baseline conditions data were collected in Fall 2014 prior to construction. Supplemental "Before" data were collected in January 2017, just prior to the beginning of express lanes operations. The Before and Supplemental Before baseline data are compared to data collected after the express lanes were opened and traffic patterns had stabilized.

Figure 1: I-680 Express Lane Location



2.2. STUDY CORRIDOR

The primary study corridor is I-680 between Alcosta Boulevard and Rudgear Road, covering the extent of the express lanes (Figure 2). Some types of data collection, specifically floating car surveys of travel time and speed, were conducted beyond the limits of the study corridor to ensure that traffic conditions can be fully assessed.

2.3. CONTROL CORRIDOR

A control corridor is defined in addition to the study corridor. The purpose of including data collection on a control corridor is to determine if any changes in travel behavior observed between the Before and After conditions are due to the opening of the express lanes or due to other external factors (economy, gas prices, commute options) that would normally influence the travel trends within the area.

The selected control corridor was defined and verified by the study stakeholder group for the Before study as southbound Contra Costa I-680 north of the study corridor between the Willow Pass Road interchange and Olympic Boulevard. This segment of southbound I-680 was chosen because it has a similar lane configuration and traffic composition as the study corridor, no anticipated major changes in configuration through the Before and After study periods, and minimal effects from the implementation of the express lanes on the study corridor.

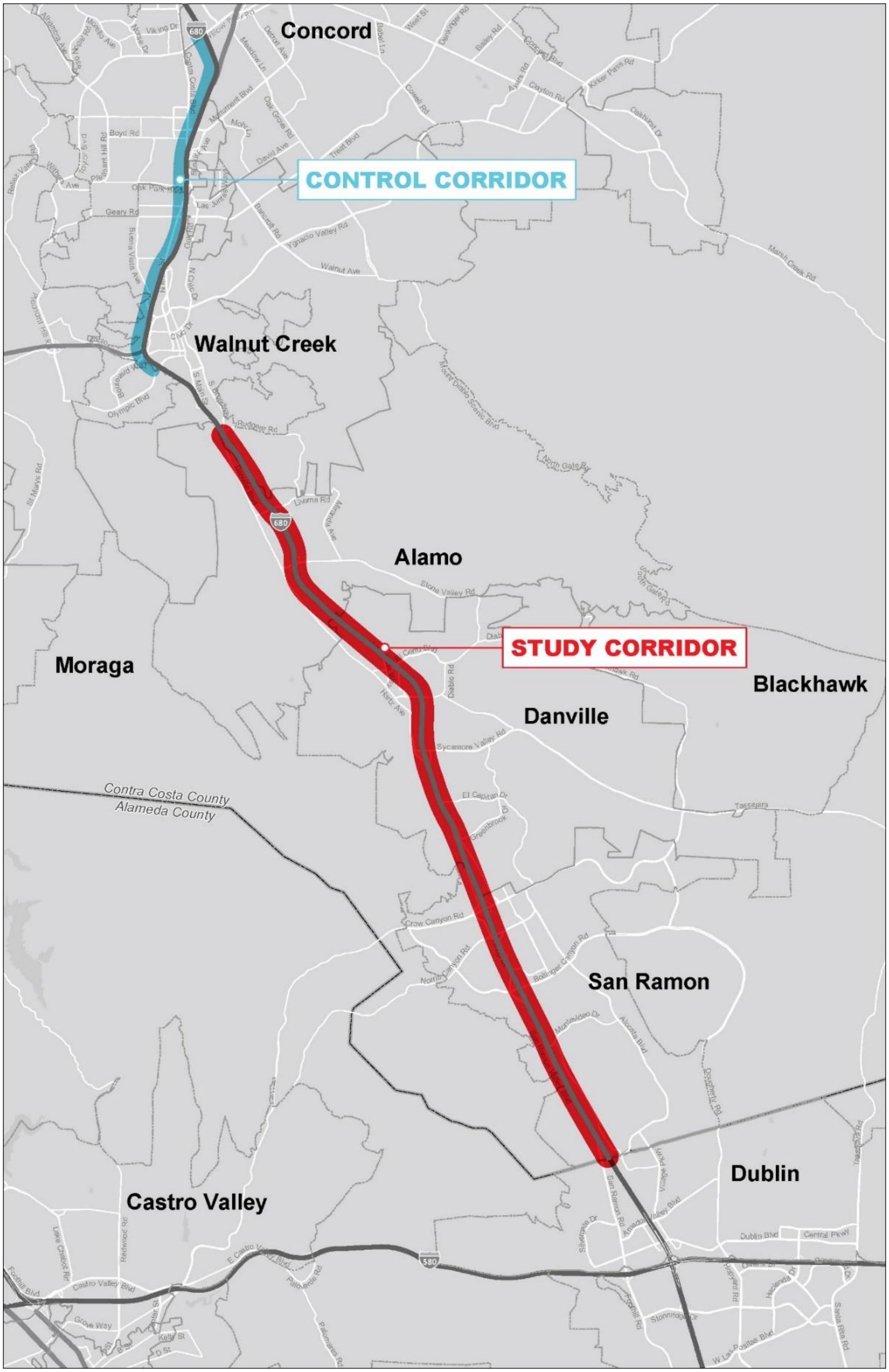
2.4. ORGANIZATION OF THE REPORT

The Before/After Study report includes the following sections:

- Chapter 1 contains the summary.
- Chapter 2 includes the introduction, the study goals, and the definitions of the study and control corridors.
- Chapter 3 lists evaluation goals and performance measures.
- Chapter 4 describes the different types of data collection.
- Chapter 5 summarizes the study methodology.
- Chapter 6 contains the data analysis and evaluation for each type of performance measure for the study corridor.
- Chapter 7 contains the data analysis and evaluation for the control corridor.
- Chapter 8 lists study conclusions.

Detailed data tabulations are included in a separate Technical Appendix.

Figure 2: Study Corridor and Control Corridor



3. EVALUATION GOALS AND MEASURES

The goal of the Before/After study is to compare the performance of the express lane corridor in relation to the set benchmarks for statutory requirements

IN THIS SECTION>>

- Express lanes goals
- Performance measures

3.1. EXPRESS LANES GOALS

The goals of the MTC express lanes program include connectivity, efficiency, and reliability (Table 1).

Table 1: Express Lanes Goals

Goal	Description
Connectivity	Close gaps within the existing HOV lane system to increase travel time savings and reliability for carpools and buses. Express lanes provide a funding mechanism to expedite completion of this network of HOV lanes.
Efficiency	Optimize capacity in Bay Area freeway corridors to better meet current and future traffic demands. Efficiency of freeway facilities can be maximized by better using excess capacity in the existing HOV system.
Reliability	Provide a reliable, congestion-free transportation option for buses, carpools, and single-occupant vehicles.

Source: MTC

3.2. PERFORMANCE MEASURES

Performance measures were established by BAIFA to evaluate the performance of the I-680 express lanes and to determine whether the stated goals of the express lane project have been met (Table 2).

All of these measures (except for Measure 11 Violations) were used in the "Before" study to establish an existing conditions baseline on the study corridor prior to the implementation of the express lanes. The same measures are used in the "After" study to compare conditions after implementation. The methodologies for evaluating these performance measures are described in Chapter 5.

Table 2: Performance Measures

	Performance Measures	Definition
1	Travel Times and Speeds	Travel time is the average time required to traverse the entire corridor in a single direction, expressed in minutes. Travel time savings for managed lane vehicles is the difference in travel time in the managed lane versus the travel time in the general purpose lanes. Speed is the average speed of vehicles traveling through the corridor, expressed in miles per hour.
2	Delay	Delay is the difference between the congested travel time and the estimated travel time without congestion (travel time based on the posted speed limit). Delay is expressed in minutes.
3	Bottlenecks, Maximum Queues, Duration of Congestion	A bottleneck is defined as a freeway segment where the traffic demand exceeds capacity; as a result, vehicle queues can be observed upstream of the bottleneck. Evaluation of bottlenecks and queues identifies the locations of bottlenecks and the length and approximate duration of queues, defined as travel speed lower than the congested speed of 35 mph.
4	Vehicle Occupancy/Classification	Vehicle occupancy is a measure of number of occupants in a vehicle. Vehicle occupancy includes measurement of single occupant vehicles (SOV) or two occupants (HOV2) or three or more occupants (HOV3+). Vehicle classification identifies the number of vehicles by type (e.g., motorcycles, low emission vehicles, buses, etc.).
5	Vehicle Throughput	Number of vehicles traversing a roadway section in one direction, expressed as vehicles per hour.
6	Person Throughput	Number of persons traversing a roadway section, expressed as persons per hour.
7	Vehicle-Hours of Delay (VHD)	Vehicle delay is expressed as vehicle-hours. Vehicle-hours of delay are estimated by multiplying the volume on each segment by the difference between the congested travel time and the estimated travel time without congestion.
8	Level of Service (LOS)	Level of service is a measure of driving conditions and vehicle delay. Level of service range from letter A (best) to F (worst).
9	Travel Time Reliability	Travel time reliability is a measure of the dispersion of the travel time distribution. Measures of travel time reliability represent a commuter's experience rather than a simple average travel time.
10	Managed Lane Speed Assessment	Minimum speed of 45 mph in managed lanes should be maintained for 90 percent of time over 180 consecutive days during morning and evening weekday peak periods.
11	Violations	Estimated percentages of vehicles in the express lane not paying the appropriate toll.

Sources: MTC, Kittelson & Associates, Inc.

4. DATA COLLECTION

IN THIS SECTION>>

- Data collection schedule
- Data collection locations
- Methodologies for data collection

The data used for the 2014 Before, 2017 Supplemental Before, and 2018 After studies included new data collected specifically for this study, as well as data compiled from other available sources. The new data collection included:

- Travel time surveys using "floating car" runs
- Manual counts of vehicle classification and occupancy at selected locations
- Automated traffic counts using Wavetronix detectors
- Visual observations with video recordings and field visits

Available data were also compiled from:

- Caltrans Freeway Performance Measurement System (PeMS)
- INRIX
- Express lane toll tag transponder detectors

4.1. DATA COLLECTION SCHEDULE

The data collection schedules for the Before, Supplemental Before, and After studies are listed in Table 3. The locations of traffic and occupancy counts are shown in Figure 3.

The field surveys and data collection for the Before study were primarily conducted during October and November 2014, with additional data collected in January 2015.

The data collection for the Supplemental Before study was conducted in late January 2017.

The Contra Costa I-680 South express lanes opened in October 9, 2017.

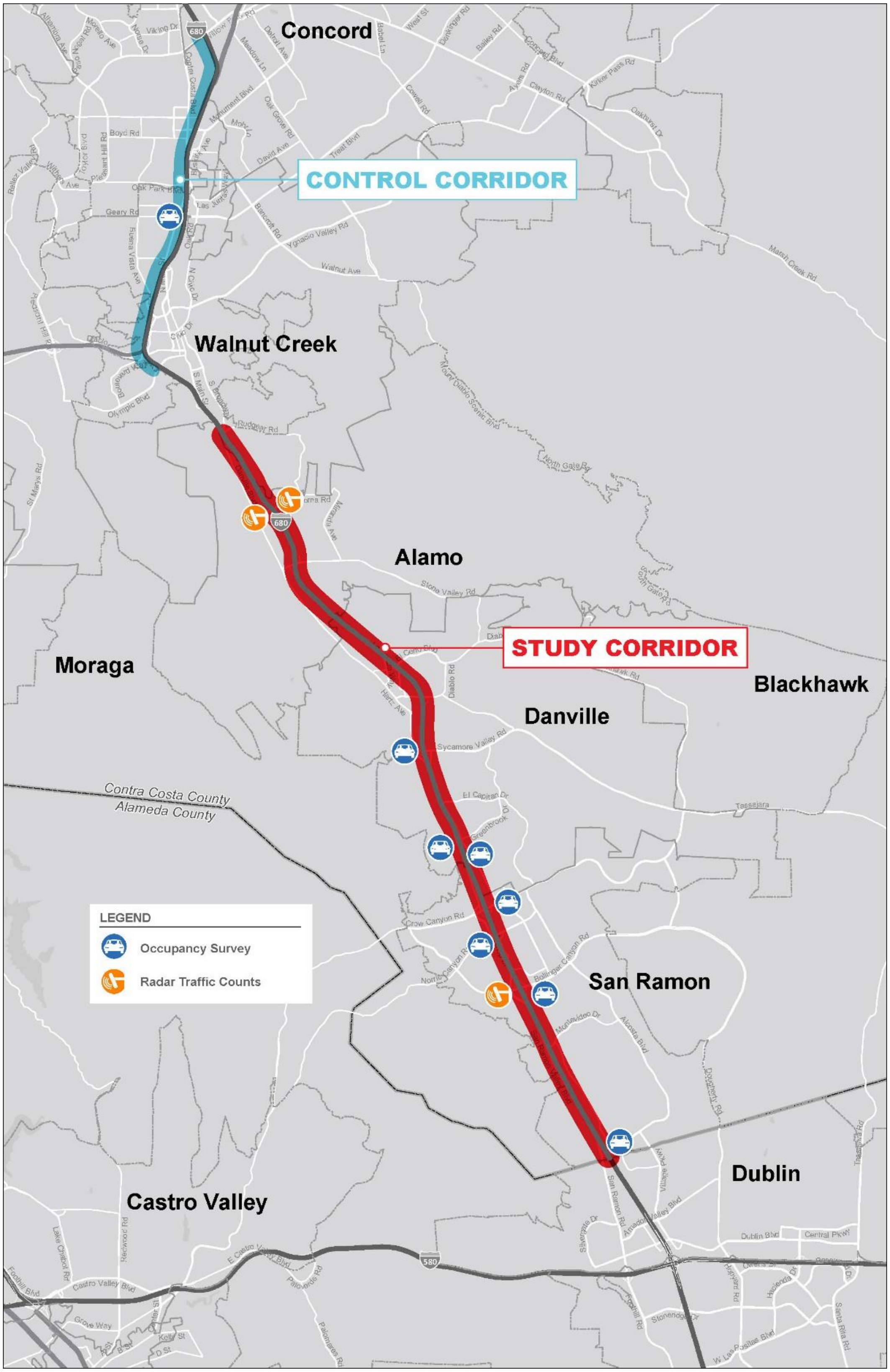
The After study data collection started in late October 2018 and continued into mid-December. The manual vehicle occupancy counts were conducted over several weeks so that the same experienced crew could conduct counts using consistent methodologies at each of the seven locations.

Table 3: Data Collection Schedules

Date	Day	Date	Notes
BEFORE STUDY			
Floating car travel time surveys (all lanes)	Tuesday Thursday Wednesday Thursday Tuesday Wednesday Thursday	October 28, 2014 (AM)[1] October 30, 2014 (PM) [1] November 5, 2014[1] November 6, 2014[1] January 13, 2015 (PM) January 14, 2015 January 15, 2015	 Incident NB late AM Incident NB+SB PM Incident NB PM Incident NB AM, SB PM
Vehicle occupancy counts	Wednesday Thursday Wednesday Thursday	October 29, 2014 (PM) October 30, 2014 (PM) November 5, 2014 (AM) November 6, 2014 (AM)	
Wavetronix traffic counts	Wednesday to Thursday	October 29, 2014, to November 6, 2014	
SUPPLEMENTAL BEFORE STUDY			
Floating car travel time surveys (HOV lane)	Tuesday Wednesday Thursday	January 24, 2017 January 25, 2017 January 26, 2017	 Incident SB AM Incident NB PM
Vehicle occupancy counts	Tuesday Thursday	January 24, 2017 January 26, 2017	
Ramp vehicle occupancy counts	Tuesday Thursday	January 24, 2017 January 26, 2017	
Ramp clean air vehicle counts	Tuesday Thursday	January 24, 2017 January 26, 2017	
AFTER STUDY			
Floating car travel time surveys (express lane)	Tuesday Wednesday Thursday	November 27, 2018 November 28, 2018 November 29, 2018	Incident NB PM Incident NB AM
Vehicle occupancy counts	Tuesday Thursday Tuesday-Thursday Tuesday Thursday Tuesday-Thursday Tuesday-Thursday Tuesday-Thursday	October 30, 2018 November 1, 2018 November 6-8, 2018 November 13, 2018 November 15, 2018 November 27-29, 2018 December 4-6, 2018 December 11-13, 2018	
Wavetronix traffic counts	Tuesday-Thursday Tuesday-Thursday	November 27-29, 2018 December 4-6, 2018	

Note: [1]Approximately 50% of travel time runs in 2014 were not recorded due to equipment failure.
Data during periods affected by incidents were excluded from the analysis.
Source: Kittelson & Associates, Inc.

Figure 3: Data Collection Locations



Source: Kittelson & Associates, Inc.

4.2. TRAVEL TIME SURVEYS

Travel time and speed data for the HOV/Express lanes were primarily based on floating car surveys during the peak periods. Travel times and speeds for the general purpose lanes were derived from data downloaded from INRIX.

Floating Car Surveys

Floating car surveys were conducted using probe vehicles equipped with Global Positioning System (GPS) equipment so that vehicle speeds could be recorded at frequent time intervals. Survey vehicles for the HOV lanes carried a passenger in addition to the driver in order to meet the occupancy requirement.

The floating car surveys extended beyond the north and south ends of the study corridor to ensure that the causes of congested flow could be identified. However, for the 2017 Supplemental Before study, the floating car surveys extended south only to Bollinger Canyon Road, not all the way south to Alcosta Boulevard. Therefore, comparisons involving the Supplemental Before study do not include the segment between Alcosta Boulevard and Bollinger Canyon Road. Floating car surveys were not conducted on the control corridor.

The time periods for the floating car surveys were from 5:00 AM to 10:00 AM (5 hours) during the AM peak period and from 3:00 PM to 7:00 PM (4 hours) during the PM peak period. Additional midday surveys (10:00 AM to 3:00 PM) were conducted during the After study. The surveys were scheduled to occur every 15 minutes during the peak periods.

The Before study also conducted floating car travel time surveys in the general purpose lanes. With INRIX data now available for all study years, the 2014 general purpose floating car surveys are not used and INRIX data are used for consistency with the After study.

INRIX Data

INRIX is a provider of real-time, historical, and predictive traffic information. INRIX works by combining anonymous, real-time GPS probe data from devices carried by commercial fleet, delivery, taxi vehicles, and smart phone users. The travel times reported by INRIX were downloaded for both the study corridor and the control corridor. The times were downloaded for 12-month periods corresponding to the data collection for the 2014 Before, 2017 Supplemental Before, and 2018 After studies:

- Before Study: February 1, 2014, to January 31, 2015
- Supplemental Before Study: October 1, 2016, to September 30, 2017
- After Study: December 1, 2017, to November 30, 2018

The travel time data were reported for each 15-minute period during all 24 hours of each day. The INRIX data are reported as the average of all freeway lanes combined, and do not differentiate between travel times on the HOV and general purpose lanes. The INRIX data were used to evaluate travel times on the control corridor in the Before and After studies and for general purpose lanes in the study corridor.

4.3. VEHICLE CLASSIFICATION AND OCCUPANCY SURVEYS

Vehicle classification and occupancy data were collected through manual observation of each freeway lane. For the 2014 Before study, one surveyor was assigned to one lane of travel to collect occupancy data. For the 2017 and 2018 studies, one surveyor was assigned to the HOV/Express lane, and a second surveyor provided sampled classification counts for the general purpose lanes. The vehicle classification categories included separate counts of drive-alone vehicles, carpools with two passengers, carpools with three or more passengers, vanpools, buses, motorcycles, and trucks. Vehicle occupancy and classification data were collected for both the study and control corridors.

Survey Locations

For the study corridor, the occupancy surveys were conducted at four northbound locations and three southbound locations (Table 4).

Table 4: Traffic Count Data Collection Locations

Location	Manual Occupancy Counts	PeMS Counts	PeMS Speeds	Radar Counts	Throughput Analysis	Level of Service Analysis
NORTHBOUND						
Amador Valley Boulevard		●				
Alcosta Boulevard[1]	●	●			●	●
Bollinger Canyon Road[1]	●	●	●		●	●
Crow Canyon Road[1]	●	●	●		●	●
Greenbrook Drive[2]	●	●	●		●	●
Stone Valley Road		●	●			●
Livorna Road		●		●		
SOUTHBOUND						
South Main Street		●				
Livorna Road				●		
Stone Valley Road		●	●			●
Sycamore Valley Road[1]	●	●	●		●	●
Greenbrook Drive[2]	●	●	●		●	●
Norris Canyon Road[1]	●	●	●		●	●
Bollinger Canyon Road				●		
Amador Valley Boulevard		●				

[1]Occupancy counts conducted from overpass.
[2]Occupancy counts conducted from viewpoint adjacent to freeway.
Source: Kittelson & Associates, Inc.

Due to the design of the I-680 freeway and the lack of street overcrossings in the north part of the study corridor, no acceptable occupancy survey locations were available north of Sycamore Valley Road.

For the control corridor, occupancy surveys were conducted at one location:

- Southbound, Oak Park Boulevard overcrossing

Survey Times

For the Before study, the occupancy surveys were set up during the five hours of the AM peak period (5:00 AM to 10:00 AM) and the four hours of the PM peak period (3:00 PM to 7:00 PM). In practice, reliable views of vehicle occupancies could not be obtained prior to 6:30 AM or after 6:00 PM due to darkness and visibility. Therefore, the AM peak period occupancy surveys were available from 6:30 AM to 10:00 AM, and the PM peak period occupancy surveys were available from 3:00 PM to 6:00 PM. The AM peak period results were summarized for the hours from 6:30 AM to 9:00 AM so that the summaries only include hours when the HOV lane is in operation.

The hours of visibility were more limited during the 2018 After study. The AM peak period counts started at 6:00 AM and provided four hours of data rather than five. In practice, reliable counts of vehicle occupancy could only be collected between 7:00 AM and 9:00 AM, and between 3:00 PM and 5:00 PM due to lighting conditions. Therefore, these two-hour periods are used for the comparison of measures involving vehicle occupancies between the Before and After studies.

Additional midday occupancy counts (10:00 AM to 3:00 PM) were collected at Greenbrook Road in the northbound and southbound directions during the Supplemental Before and After studies.

For all surveys, total vehicle counts in each surveyed lane were collected for the entire AM and PM peak periods, even during times when vehicle occupancies could not be recorded.

4.4. TRAFFIC COUNTS

Traffic counts for the study and control corridors were primarily obtained from the Caltrans Freeway Performance Measurement System (PeMS). Additional traffic count data were collected in three locations using radar detectors. The radar counts were primarily used for verification of the PeMS data.

PeMS

The Caltrans Freeway Performance Measurement System (PeMS) database can provide traffic count and travel speed data for each individual lane at selected locations where loop detectors are operating. The PeMS data were used for traffic count totals and for travel time reliability measures on the HOV/Express lanes. The PeMS data were not used as the primary source for reporting travel speeds and times; the floating car surveys and INRIX data were the primary sources for speeds and times.

The PeMS volume data were downloaded and compiled for each midweek day (Tuesday to Thursday) for four-week periods corresponding to the data collection for the 2014 Before and 2018 After studies:

- Before Study: September 30, 2014, to October 30, 2014
- After Study: October 2, 2018, to November 8, 2018

The PeMS data were compiled for a total of 13 locations: 7 northbound and 6 southbound (Table 4, page 17). These include detectors at or near the seven locations of the manual occupancy counts, plus six additional locations used for the evaluations of level of service and vehicle-hours of delay. The PeMS volume data were downloaded for 5-minute periods and were aggregated to 15-minute periods.

Individual loop detectors do not always operate acceptably, so the PeMS data were screened to ensure that the analysis only includes data from detectors with acceptable operation during the survey period. For each detector, the PeMS system reports an estimated "data quality" percentage of acceptable operation during a given time period. If a detector is not providing data, the PeMS system uses information from adjacent detectors and historical records to impute the missing count and speed information. For this study, results for a set of detectors at a specific freeway location during a specific hour were only used if the data quality percentage was reported as 80 percent or higher.

Additional PeMS data were downloaded for the Managed Lane Speed Assessment performance measure. These data focused on reported hourly speeds in the managed lane (Lane 1) and were compiled for the following six-month periods:

- Before Study: July 1, 2014, to December 31, 2014
- After Study: July 1, 2018, to December 31, 2018

The six-month period ensured that there would be 180 consecutive days of data available for the speed assessment.

Freeway Mainline Radar Counts

Continuous volume counts were collected using Wavetronix radar units at three locations on the study corridor for two full weekdays (48 hours of data):

- I-680 south of Bollinger Canyon Road (southbound only)
- I-680 south of Livorna Road (northbound and southbound)

These three traffic count locations supplement the total traffic counts available from the seven occupancy survey locations on the study corridor. The Wavetronix counts were also used to verify the traffic counts available from the PeMS system.

4.5. VISUAL OBERVATIONS

Engineers conducted field surveys of traffic conditions during the AM and PM peak periods. The engineers noted operational issues and driver behavior. The field review for the 2014 Before study included video from a camera mounted on the dashboard. The field review for the 2017 Supplemental Before study included visual observations but not video. The videos were reviewed to confirm traffic conditions in each segment and the effects of reported incidents.

4.6. INCIDENT MONITORING

Incident reports for the study corridor and control corridor were monitored and logged during all data collection periods. The reports were based on text messages from the 511.org website and California Highway Patrol (CHP) reports from 511.org, as well as timed downloads from Google Traffic reports. As travel times were summarized for the various survey days, the travel times were reviewed both for occurrence during reported incidents as well as comparison of values with other incident-free days. Many travel-time runs were excluded from averages or summaries. However, in some cases the reported incidents had little effect on travel times, and the data were included in the calculations.

4.7. TOLL TAG DATA

For the After study only, data summaries from express lane toll tag detectors were provided for specific dates corresponding to vehicle occupancy surveys. The data summaries included the number of vehicles recorded as one-person (by transponder or by license plate imaging), two-person (based on transponder switch), three-plus persons (based on transponder switch), or unclassified. The toll tag data were provided for the following locations:

- Alcosta Boulevard (Southbound)
- Crow Canyon Road (Northbound and Southbound)
- Livorna Road (Northbound)

The data were summarized by 15-minute intervals for each survey day. This information was compared to manual vehicle occupancy counts to help estimate violations.

5. EVALUATION METHODOLOGY

The evaluation of corridor performance for a majority of the performance measures was developed directly from the data collected, including travel times, speeds, and vehicle occupancy. Additional analysis was required for level of service and reliability measures. This section describes the methodologies used to evaluate each performance measure.

IN THIS SECTION>>

- Evaluation time periods
- Methodologies for calculating performance measures

5.1. EVALUATION TIME PERIODS

The time periods for evaluation of performance measures vary depending on the underlying data source (Table 5).

Table 5: Performance Measure Time Periods

Performance Measure	AM Peak Period	PM Peak Period
3. Bottlenecks and Queues 4. Duration of Congestion 6. Vehicle Throughput 8. Vehicle-Hours of Delay 9. Level of Service 10. Travel Time Reliability	5:00 AM to 10:00 AM	3:00 PM to 7:00 PM
1. Travel Times and Speeds 2. Delay 11. Managed Lane Speed Assessment	5:00 AM to 9:00 AM	3:00 PM to 7:00 PM
5. Vehicle Occupancy/ Classification 7. Person Throughput	7:00 AM to 9:00 AM	3:00 PM to 5:00 PM

Source: Kittelson & Associates, Inc.

The high-occupancy vehicle (HOV) lanes on the I-680 study corridor operated from 5:00 AM to 9:00 AM and from 3:00 PM to 7:00 PM. Traffic data were collected for one additional hour in the AM peak period, resulting in a five-hour AM peak period and four-hour PM peak period for data collection and performance measure evaluation.

For vehicle occupancy, visibility constraints resulted in shorter periods for reliable data collection. Performance measures based on vehicle occupancy counts generally cover two hours during the AM peak period and two hours during the PM peak period.

5.2. PERFORMANCE MEASURES

Measure 1: Travel Times and Speeds

The travel times and speeds for the HOV/Express lanes in the study corridor are reported based on the GPS-equipped "floating car" travel time surveys. Data downloaded from INRIX were used for the general purpose lane times and speeds. The Before study included floating car surveys for the general purpose lanes as well as the HOV lane. These Before floating car surveys for the general purpose lanes were not used for this evaluation, and instead INRIX data are used for consistency with the Supplemental Before and After studies.

The travel times and speeds for the control corridor are reported based only on the INRIX travel time data. No separate floating car surveys were conducted on the control corridor.

For the floating car surveys in the HOV/Express lanes, the reported travel times and speeds represent the average of all travel time survey runs on all survey days wherever possible. In some cases, an incident or other anomaly occurred that made the data from one day not representative of average conditions. In those cases, the data from the non-representative survey day were not used, and the reported travel times represent the averages from the remaining survey days.

For the INRIX data, a full year of midweek days (Tuesday to Thursday) were processed for each study period. The median (50^{th} percentile) travel time was determined for each 15-minute period on each subsegment (generally a section of the freeway between two ramp junctions). The INRIX data represent the times and speeds in all lanes including the HOV/Express lanes. In order to derive the times and speeds for the general purpose lanes only, the INRIX results for all lanes were processed using a weighted averaging formula of the times and volumes in the managed lanes and general purpose lanes. The general formula is:

- General Purpose Lanes Time = ([INRIX All Lanes Time] * [PeMS All Lanes Volume] – [Floating Car Managed Lane Time] * [PeMS Managed Lane Volume]) / [PeMS GP Lanes Volume]

The calculation was done for the entire study corridor rather than subsegments, and separately for each 15-minute period.

Measure 2: Delay

Delay is calculated as the difference in travel time between the measured congested travel time and the estimated travel time without congestion ("free-flow time"). The estimated travel time without congestion is calculated as the distance divided by the posted speed limit, which is 65 miles per hour on the I-680 corridor.

Measure 3: Bottlenecks, Queues and Duration

Bottlenecks and queues were identified using the speed-contour maps created using the floating car travel time surveys on the HOV/Express lanes and adjusted INRIX data on the general purpose lanes. Speeds less than 35 mph were noted as potential queue locations. The locations that were consistently at the downstream end of the congested segments were noted as potential bottleneck locations.

Locations of congestion and potential causes were confirmed through driving the corridors during peak periods, including video logging of observed traffic conditions.

Duration of congestion is defined as the period of time during a peak period when one or more segments operated below 35 miles per hour. The duration was identified through manual observation of the speed contour maps. The start time and end time for speeds less than 35 miles per hour were noted for each segment with consistent congestion on all survey days. The average difference between the start time and end time was reported as the duration of congestion for the corresponding segment.

Measure 4: Vehicle Occupancy/Classification

The vehicle occupancy analysis was based directly on the manual counts of vehicle classification and occupancy conducted at seven locations on the study corridor and one location on the control corridor. Two days of count data were reviewed for each location, both in terms of total volumes as well as percentages of classifications. If an incident or other anomaly occurred that made the data from one day not representative of average conditions, the data from the non-representative survey day would not be used and the reported vehicle occupancies would represent the results from one survey day.

Time periods with a high percentage of vehicles classified as "unknown" during the manual counts were excluded from the summary calculations. Most of these occurred during the morning peak period prior to 6:00 AM and the PM peak period after 5:00 PM, when visibility was limited.

An average number of persons per vehicle were assumed for each vehicle classification (Table 6), consistent with the Caltrans Managed Lanes reports. These average persons per vehicle were multiplied by the numbers of each vehicle type to estimate the total persons. The average vehicle occupancies were calculated by dividing the total persons in vehicles by the numbers of vehicles for each period.

Table 6: Vehicle Occupancy Assumptions

Vehicle Classification	Persons per Vehicle
Single occupant auto	1.0
Two-person carpool	2.0
Three-plus carpool	3.5
Motorcycle	1.0
Heavy Vehicle	1.0
Bus	35.0

Source: Caltrans Managed Lanes Report

Measure 5: Vehicle Throughput

The vehicle throughput is based primarily on the Caltrans PeMS counts aggregated to 15-minute intervals. The Wavetronix traffic counts were compared to PeMS counts in similar locations to verify the accuracy of the PeMS counts. The manual vehicle occupancy counts were initially used to calculate throughput during the Before study, but for consistency with the After study, the manual counts have been replaced by PeMS counts from the corresponding Before survey time periods.

Twelve days of PeMS count data were used wherever possible for each location, representing four weeks of midweek (Tuesday to Thursday) days incorporating the days when occupancy and floating car surveys were conducted. In some cases, an incident or other anomaly occurred that made the data from one day not representative of average conditions. In those cases, the data from the non-representative day were excluded and the reported traffic counts represent the average of the results from the remaining days.

Measure 6: Person Throughput

The person throughput was calculated based on the vehicle throughput counts multiplied by the percentage of each vehicle occupancy classification from the manual occupancy counts, and then multiplied by the average vehicle occupancies for each vehicle type as listed in Table 6. The calculation is done separately for each 15-minute period. Person throughput is only reported at locations and during time periods where vehicle occupancies were surveyed.

Measure 7: Vehicle-Hours of Delay

Vehicle-hours of delay (VHD) are calculated as the hours of delay on each segment (congested time minus free-flow time) multiplied by the number of vehicles on the segment. The VHD for each hour period were calculated separately for the HOV/Express lanes and the general purpose lanes.

The PeMS data were used to provide volumes to calculate vehicle-hours of delay. Each PeMS traffic count location was assigned to a segment of the freeway, with the segments generally defined as half the distance to the next count location in each direction. The 15-minute average counts for each location were aggregated to hourly totals.

The travel times on each subsegment were used as the measures of travel time and delay. As described in the methodology for Measure 1, the travel times on the HOV/Express lanes are averages from the floating car surveys, while the travel times on the general purpose lanes are calculated based on the median values from one year of INRIX data.

The travel times on each subsegment were multiplied by the corresponding average PeMS volumes to calculate total vehicle-hours. The same PeMS volumes may be used for several subsegments, while the travel times are unique to each subsegment. The free-flow vehicle-hours were calculated as the same volumes multiplied by the travel time corresponding to 65 miles per hour. The VHD is then the difference between the observed total vehicle-hours and the free-flow vehicle-hours.

Measure 8: Level of Service

Level of Service Definition

Traffic operations performance is evaluated in terms of "level of service" (LOS), which is a measure of driving conditions and vehicle delay. Levels of service range from A (best) to F (poorest). Levels of service A, B and C indicate conditions where traffic can move relatively freely. Level of service D describes conditions where delay is more noticeable. Level of service E describes conditions where traffic volumes are at or close to capacity. Level of service F characterizes conditions with unstable flow, where freeway operations break down, with very slow speeds (stop and go), long delays, and queuing.

The LOS for freeway segments was evaluated based on the methodology outlined in the *Highway Capacity Manual* (HCM). The LOS is determined based on density, which is the number of vehicles occupying a given length of a lane or roadway at a particular instant. The HCM states that density characterizes the quality of traffic operations because it describes the proximity of vehicles to one another and reflects the freedom to maneuver within the traffic stream. In the HCM, an estimate of density is calculated based on various inputs, such as flow rate and lane geometry. Table 7 shows the density thresholds based on the HCM.

Table 7: Highway Capacity Manual Freeway Level of Service Criteria

Level of Service	Density (passenger cars/mile/lane)
A	≤11.0
B	>11.0 – ≤18.0
C	>18.0 – ≤26.0
D	>26.0 – ≤35.0
E	>35.0 – ≤45.0
F	> 45.0

Source: Transportation Research Board, *Highway Capacity Manual 2010*, Washington, DC, 2010

The HCM bases level of service on traffic density rather than speed, so LOS results are not directly comparable to speed-based LOS estimates.

Level of Service Calculation

Vehicle densities are calculated directly by dividing counted vehicles (vehicles per hour) from the PeMS data by observed speed (miles per hour), and dividing by the number of lanes. The calculated densities for HOV/Express and general purpose lanes are then compared to the LOS thresholds. The LOS was calculated at 10 selected locations (5 northbound, 5 southbound) including the 7 locations where manual occupancy counts were available, plus 3 additional locations where PeMS counts were compiled (Table 4, page 17).

Measure 9: Travel Time Reliability

Travel time variability is used in this study to provide information on the reliability of travel times in the corridors. The following statistics for travel time are computed by time of day to measure travel time variability on the study and control corridors:

- 50th and 95th percentile travel times by time period
- Travel Time Index (50th percentile travel time divided by free-flow travel time)
- Planning Time Index (95th percentile travel time divided by free-flow travel time)

The reliability measures are calculated separately for the HOV/Express and general purpose lanes.

A high number of observations are required to measure travel time variability. Therefore, the relatively limited number of floating car travel time surveys could not be used for this purpose. The evaluation instead uses the PeMS data for the HOV/Express lanes and INRIX data for the general purpose lanes. However, INRIX reports the travel times on all lanes of the freeway combined, and does not distinguish between the HOV/Express lane and the general purpose lanes. The INRIX data were used for reliability measures on all lanes to represent conditions on the general purpose lanes.

The identification of 50th and 95th percentile travel times for each study period was based on a full year of data for midweek days (Tuesday to Thursday):

- Before Study: February 1, 2014, to January 31, 2015
- Supplemental Before Study: October 1, 2016, to September 30, 2017
- After Study: December 1, 2017, to November 30, 2018

The same one year periods were used for both the PeMS data and the INRIX data.

Measure 10: Managed Lane Speed Assessment

The statutory requirement for travel speeds in managed lanes is as follows:

"Facility degradation is defined in Section 166(d)(2) as one that does not meet minimum average operating speed of 45 MPH for 90 percent of the time over a 180-day monitoring period during morning and evening weekday peak hours (or both), in the case of a HOV facility with a speed limit of 50 MPH or greater, or not more than 10 MPH below the speed limit in the case of a facility with a speed limit of less than 50 MPH."

The requirement to evaluate separate travel speed information on the managed lanes means that INRIX data cannot be used, as it reports the averages for all lanes. Therefore, the managed lane speed assessment measure must be based on detectors in the managed lanes. The PeMS data were used for this analysis.

The PeMS data for selected detector stations in the corridor were compiled for all weekdays (Monday through Friday) in July 1 through December 31, in 2014 for the Before study and in 2018 for the After study. The average hourly speed measurements for Lane 1, representing the HOV lane, were reviewed for the hours of HOV operation (5:00 to 9:00 AM and 3:00 to 7:00 PM). The number of hours during the six month (180+ day) period where the speed was less than 45 miles per hour were tabulated for each detector station, and compared to the total number of peak period hours during the six month period to determine the percentages for the speed assessment. These percentages were then compared to the 10 percent threshold.

Measure 11: Violations

Express lane violations were estimated for the After study only.

The toll tag data provided at four locations were compiled to represent the number of vehicles declaring themselves as single occupant, two person or three-plus persons for each 15 minute period during the AM and PM peak periods. Motorcycles and clean air vehicles (CAV) were assumed to use the 3+ toll tag setting. Image-based trips reported by the toll tag data were assumed to be single-occupant vehicles.

The nearest manual vehicle occupancy count location was selected for each of the four toll tag locations. The vehicle occupancy counts were factored to eliminate unknowns and consolidated into SOV, HOV2 and HOV3+ categories for comparison to the toll tag readings (motorcycles and trucks were included in SOV, buses in HOV3+). The occupancy counts and toll tag counts were compared for each 15-minute period to ensure general consistency. Because the manual counts were not always in the identical location as the toll tag counts, the manual counts were factored to match the toll tag total vehicle counts for each 15-minute period. This assumes that the percentages of vehicle occupancy categories would be relatively constant between the two nearby locations. The factored manual counts were then compared directly to the toll tag data.

The SOVs in the factored manual occupancy counts were reduced by the number of clean air vehicles (CAVs) recorded for each 15-minute period as part of the manual counts. The remaining SOVs were assumed to be vehicles that should pay tolls. These SOV totals were compared to the SOVs reported in the toll tag data for each 15-minute period. If the counted SOVs were less than or equal to the SOV detector totals, it is assumed that the tolls captured all of the toll-eligible vehicles. If the counted SOVs were greater than the tolled SOVs during a 15-minute period, it is assumed that the difference represents SOVs who had not declared as SOVs on their transponders. These potential violations were summed for each 15-minute period and compared to the total vehicle volumes for the comparable time periods.

For 15-minute periods where the manual vehicle occupancy counts had more than 50 percent unknowns due to low visibility, those 15-minute periods were excluded from the violations estimates and percentages.

6. STUDY CORRIDOR PERFORMANCE MEASURES

Each of the performance measures were evaluated for the I-680 study corridor. Selected performance measures for the control corridor are described in Chapter 7.

IN THIS SECTION>>

- Results for 11 performance measures on study corridor

6.1. MEASURE 1: TRAVEL TIMES AND SPEEDS

Corridor travel times are reported based on the floating car surveys for the HOV/Express lanes and adjusted INRIX data for the general purpose (GP) lanes. The average travel times and speeds for each 15-minute period were calculated based on the useable travel time runs during that 15-minute period from each of the survey days. The average travel times were calculated separately for HOV/Express and general purpose lanes, and the travel time savings for the HOV/Express lanes are listed.

Travel Times

HOV/Express Lanes

Travel times and speeds for the HOV/Express lanes were compiled for the 2014 Before study, the 2017 Supplemental Before study and the 2018 After study (Table 8 to Table 11 and Figure 4 to Figure 7). Because the southern terminus for the floating car surveys for the Supplemental Before study was Bollinger Canyon Road rather than the end of the HOV/Express lanes at Alcosta Boulevard, a shorter study segment was reported to allow direct comparison of all three studies.

AM Peak Period

In the AM peak period, northbound and southbound travel times do not show significant variation between the Before and After studies. The highest times reported in the northbound direction were 9.1 minutes during the Before study, 10.8 minutes in the Supplemental Before study and 9.5 minutes in the After study. The highest times reported in the southbound direction were 9.5 minutes during the Before study, 9.7 minutes in the Supplemental Before study and 9.8 minutes in the After study. The highest travel times occurred later in the AM peak period (after 8:00 AM) and were about 40 percent higher than the times reported in the early hours. However, the speed information indicates that many vehicles were traveling much faster than the posted speed limit during the early hours.

PM Peak Period

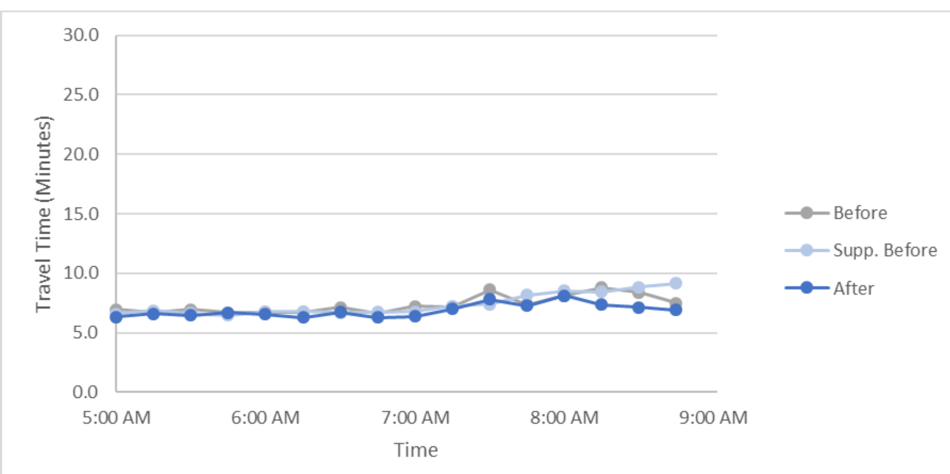
The PM peak period southbound results were similar to the AM peak period, with little variation between the Before and After studies and about one to two minutes of difference between the slowest and fastest times. The northbound results in the PM peak period show much more variation. Significant delays were reported in the HOV lane during the Before study. These delays had reduced somewhat by 2017, and were further reduced following implementation of the express lanes.

Table 8: Express/HOV Lane Travel Times and Speeds, AM Peak Period, Northbound

	Travel Time (Minutes)			Speed (Miles per Hour)		
	HOV Lane	HOV Lane	Express Lane	HOV Lane	HOV Lane	Express Lane
Time	Before (2014)	Supp. Before (2017)	After (2018)	Before (2014)	Supp. Before (2017)	After (2018)
5:00 AM	7.0	6.6	6.3	71	76	79
5:15 AM	6.7	6.8	6.6	74	73	75
5:30 AM	6.9	6.6	6.5	72	75	77
5:45 AM	6.7	6.4	6.7	74	77	74
6:00 AM	6.7	6.8	6.6	74	74	76
6:15 AM	6.7	6.8	6.3	74	73	79
6:30 AM	7.1	6.7	6.7	70	74	74
6:45 AM	6.6	6.7	6.3	75	74	79
7:00 AM	7.2	6.8	6.4	69	73	78
7:15 AM	7.2	7.2	7.0	69	69	71
7:30 AM	8.6	7.4	7.8	58	67	64
7:45 AM	7.3	8.1	7.3	68	61	69
8:00 AM	8.1	8.5	**8.1**	61	58	61
8:15 AM	**8.8**	8.4	7.4	57	59	68
8:30 AM	8.4	8.8	7.1	59	56	70
8:45 AM	7.5	**9.2**	6.9	67	54	72

Notes:
HOV lane ended operation at 9:00 AM.
Northbound from Bollinger Canyon Rd. On-Ramp to Livorna Rd. On-Ramp (8.3 miles)
Data Source: Floating car runs by Metro Traffic Data, Inc.

Figure 4: Express/HOV Lane Travel Times, AM Peak Period, Northbound



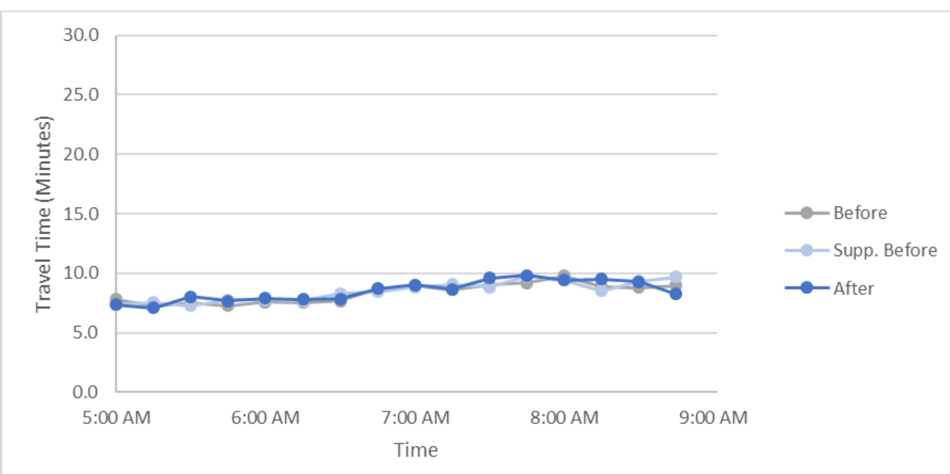
Data Source: Floating car runs by Metro Traffic Data, Inc.

Table 9: Express/HOV Lane Travel Times and Speeds, AM Peak Period, Southbound

	Travel Time (Minutes)			Speed (Miles per Hour)		
	HOV Lane	HOV Lane	Express Lane	HOV Lane	HOV Lane	Express Lane
Time	Before (2014)	Supp. Before (2017)	After (2018)	Before (2014)	Supp. Before (2017)	After (2018)
5:00 AM	7.8	7.4	7.3	70	74	75
5:15 AM	7.2	7.5	7.1	75	73	78
5:30 AM	7.5	7.3	8.0	73	76	69
5:45 AM	7.3	7.8	7.7	75	71	72
6:00 AM	7.6	7.8	7.9	72	71	70
6:15 AM	7.5	7.7	7.8	72	72	70
6:30 AM	7.7	8.3	7.9	71	67	70
6:45 AM	8.7	8.4	8.7	63	65	64
7:00 AM	9.0	8.8	9.0	61	62	61
7:15 AM	8.6	9.1	8.7	64	61	64
7:30 AM	9.0	8.8	9.6	61	62	57
7:45 AM	9.2	**9.7**	**9.8**	59	57	56
8:00 AM	**9.8**	9.4	9.4	56	58	59
8:15 AM	8.9	8.5	9.5	61	65	58
8:30 AM	8.8	9.3	9.3	62	59	59
8:45 AM	9.0	**9.7**	8.3	61	57	67

Notes:
HOV lane ended operation at 9:00 AM.
Southbound from Rudgear Rd. On-Ramp to Bollinger Canyon Rd. Off-Ramp (9.1 miles)
Data Source: Floating car runs by Metro Traffic Data, Inc.

Figure 5: Express/HOV Lane Travel Times, AM Peak Period, Southbound



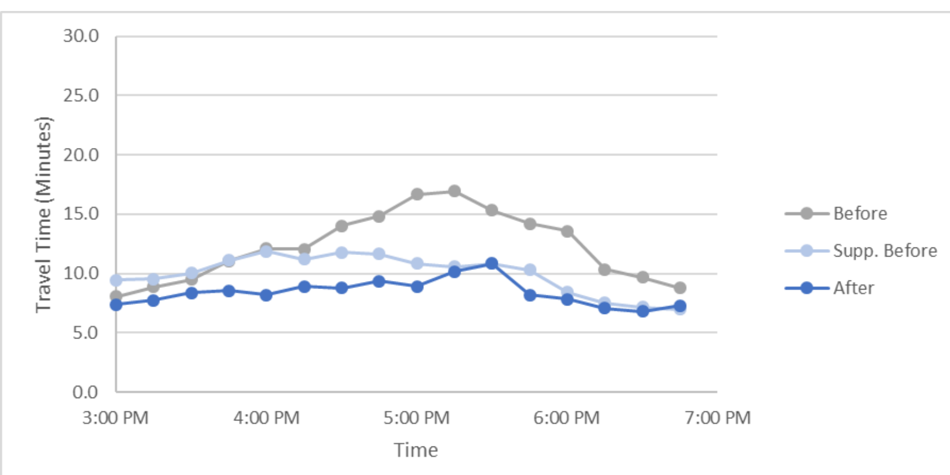
Data Source: Floating car runs by Metro Traffic Data, Inc.

Table 10: Express/HOV Lane Travel Times and Speeds, PM Peak Period, Northbound

	Travel Time (Minutes)			Speed (Miles per Hour)		
	HOV Lane	HOV Lane	Express Lane	HOV Lane	HOV Lane	Express Lane
Time	Before (2014)	Supp. Before (2017)	After (2018)	Before (2014)	Supp. Before (2017)	After (2018)
3:00 PM	8.1	9.5	7.4	62	53	67
3:15 PM	8.8	9.5	7.7	56	52	64
3:30 PM	9.5	10.0	8.4	52	50	59
3:45 PM	11.0	11.1	8.6	45	45	58
4:00 PM	12.1	**11.9**	8.2	41	42	61
4:15 PM	12.1	11.2	8.9	41	44	56
4:30 PM	14.0	11.8	8.8	35	42	57
4:45 PM	14.8	11.7	9.4	34	43	53
5:00 PM	16.7	10.8	8.9	30	46	56
5:15 PM	**16.9**	10.6	10.2	29	47	49
5:30 PM	15.3	10.8	**10.9**	33	46	46
5:45 PM	14.2	10.3	8.2	35	48	61
6:00 PM	13.6	8.4	7.8	37	59	64
6:15 PM	10.3	7.5	7.1	48	66	70
6:30 PM	9.7	7.2	6.8	51	70	73
6:45 PM	8.8	7.0	7.3	57	71	68

Notes:
Northbound from Bollinger Canyon Rd. On-Ramp to Livorna Rd. On-Ramp (8.3 miles)
Data Source: Floating car runs by Metro Traffic Data, Inc.

Figure 6: Express/HOV Lane Travel Times, PM Peak Period, Northbound



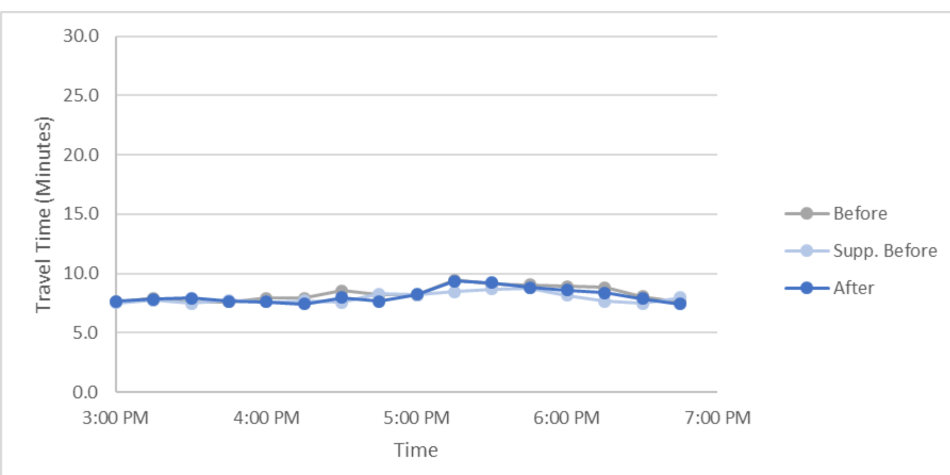
Data Source: Floating car runs by Metro Traffic Data, Inc.

Table 11: Express/HOV Lane Travel Times and Speeds, PM Peak Period, Southbound

	Travel Time (Minutes)			Speed (Miles per Hour)		
	HOV Lane	HOV Lane	Express Lane	HOV Lane	HOV Lane	Express Lane
Time	Before (2014)	Supp. Before (2017)	After (2018)	Before (2014)	Supp. Before (2017)	After (2018)
3:00 PM	7.6	7.5	7.6	72	74	72
3:15 PM	7.9	7.7	7.8	69	71	70
3:30 PM	7.6	7.5	7.9	72	74	70
3:45 PM	7.6	7.8	7.7	72	71	72
4:00 PM	7.9	7.6	7.6	69	72	72
4:15 PM	7.9	7.7	7.4	69	72	74
4:30 PM	8.6	7.6	8.0	64	73	69
4:45 PM	8.2	8.3	7.7	67	67	72
5:00 PM	8.2	8.2	8.3	67	67	67
5:15 PM	**9.4**	8.5	**9.4**	58	65	59
5:30 PM	9.1	8.7	9.2	60	63	60
5:45 PM	9.0	**8.8**	8.8	60	63	62
6:00 PM	8.9	8.1	8.6	61	68	64
6:15 PM	8.8	7.7	8.4	62	72	66
6:30 PM	8.0	7.5	7.9	68	74	70
6:45 PM	7.6	8.0	7.4	72	69	74

Notes:
Southbound from Rudgear Rd. On-Ramp to Bollinger Canyon Rd. Off-Ramp (9.1 miles)
Data Source: Floating car runs by Metro Traffic Data, Inc.

Figure 7: Express/HOV Lane Travel Times, PM Peak Period, Southbound



Data Source: Floating car runs by Metro Traffic Data, Inc.

In summary, the introduction of the express lanes did not result in longer travel times compared to the HOV lanes as surveyed in 2014 and 2017, and shorter travel times were observed in the most congested time period and direction, PM peak period northbound.

General Purpose Lanes

Travel times and speeds for the general purpose lanes were compiled for the 2014 Before study, the 2017 Supplemental Before study and the 2018 After study (Table 12 to Table 15 and Figure 8 to Figure 11). For consistency with the HOV/Express lane travel times, the shorter study segment was reported using the southern terminus for the Supplemental Before floating car surveys at Bollinger Canyon Road rather than the end of the HOV/Express lanes at Alcosta Boulevard.

AM Peak Period

The AM peak period travel times increased throughout the morning during the Before, Supplemental Before and After studies, with travel times in the 8:00 AM hour being about 40 percent higher than times at the beginning of the period. There was little difference between the travel times before and after the implementation of the express lanes.

PM Peak Period

The northbound results in the PM peak period showed significant delays in the Before study, peaking around 5:30 PM. The highest travel times observed in the Before study (up to 24 minutes) decreased to about 15 minutes by the 2017 Supplemental Before study and then stayed relatively constant in the After study.

The PM peak period southbound conditions were similar to the AM peak period, with little variation between the Before and After studies and about two to three minutes of difference between the slowest and fastest times.

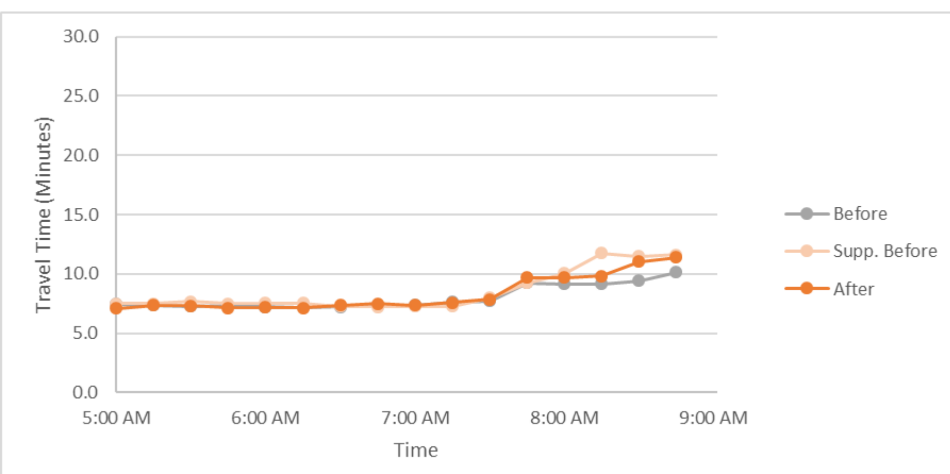
In summary, the implementation of the express lanes did not result in longer travel times in the general purpose lanes.

Table 12: General Purpose Lane Travel Times and Speeds, AM Peak Period, Northbound

	Travel Time (Minutes)			Speed (Miles per Hour)		
	GP Lanes	GP Lanes	GP Lanes	GP Lanes	GP Lanes	GP Lanes
Time	Before (2014)	Supp. Before (2017)	After (2018)	Before (2014)	Supp. Before (2017)	After (2018)
5:00 AM	7.5	7.5	7.1	66	66	70
5:15 AM	7.4	7.5	7.3	67	66	67
5:30 AM	7.2	7.6	7.3	68	65	68
5:45 AM	7.3	7.5	7.1	68	66	69
6:00 AM	7.2	7.5	7.2	69	66	69
6:15 AM	7.2	7.5	7.2	69	66	69
6:30 AM	7.2	7.3	7.4	69	68	67
6:45 AM	7.3	7.2	7.5	67	69	66
7:00 AM	7.4	7.3	7.4	67	68	67
7:15 AM	7.6	7.3	7.6	65	68	65
7:30 AM	7.7	8.0	7.8	64	62	63
7:45 AM	9.3	9.3	9.7	53	53	50
8:00 AM	9.2	10.0	9.7	54	49	51
8:15 AM	9.1	**11.8**	9.8	54	41	49
8:30 AM	9.4	11.5	11.0	52	43	43
8:45 AM	**10.1**	11.6	**11.4**	48	42	41

Notes:
HOV lane ended operation at 9:00 AM.
Northbound from Bollinger Canyon Rd. On-Ramp Livorna Rd. On-Ramp (8.3 miles)
Data Source: INRIX, Floating car runs by Metro Traffic Data, Inc.

Figure 8: General Purpose Lane Travel Times, AM Peak Period, Northbound



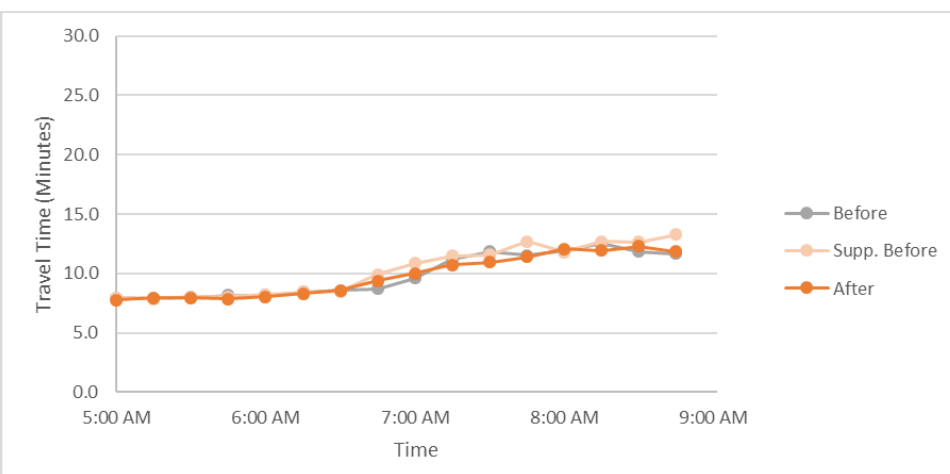
Data Source: INRIX, Floating car runs by Metro Traffic Data, Inc.

Table 13: General Purpose Lane Travel Times and Speeds, AM Peak Period, Southbound

	Travel Time (Minutes)			Speed (Miles per Hour)		
	GP Lanes	GP Lanes	GP Lanes	GP Lanes	GP Lanes	GP Lanes
Time	Before (2014)	Supp. Before (2017)	After (2018)	Before (2014)	Supp. Before (2017)	After (2018)
5:00 AM	7.9	8.0	7.8	69	69	71
5:15 AM	7.9	7.9	7.9	69	70	69
5:30 AM	8.0	8.0	8.0	69	68	69
5:45 AM	8.2	8.0	7.9	67	68	70
6:00 AM	8.2	8.2	8.0	67	67	68
6:15 AM	8.4	8.4	8.3	65	65	66
6:30 AM	8.6	8.5	8.5	64	65	64
6:45 AM	8.7	9.9	9.4	63	55	59
7:00 AM	9.6	10.9	10.0	57	50	55
7:15 AM	11.2	11.5	10.7	49	47	51
7:30 AM	11.8	11.6	10.9	46	47	50
7:45 AM	11.5	12.7	11.4	47	43	48
8:00 AM	11.9	11.8	12.0	46	46	45
8:15 AM	**12.5**	12.7	11.9	43	42	46
8:30 AM	11.8	12.7	**12.3**	46	43	44
8:45 AM	11.7	**13.3**	11.8	47	41	45

Notes:
HOV lane ended operation at 9:00 AM.
Southbound from Rudgear Rd. On-Ramp to Bollinger Canyon Rd. Off-Ramp (9.1 miles)
Data Source: INRIX, Floating car runs by Metro Traffic Data, Inc.

Figure 9: General Purpose Lane Travel Times, AM Peak Period, Southbound



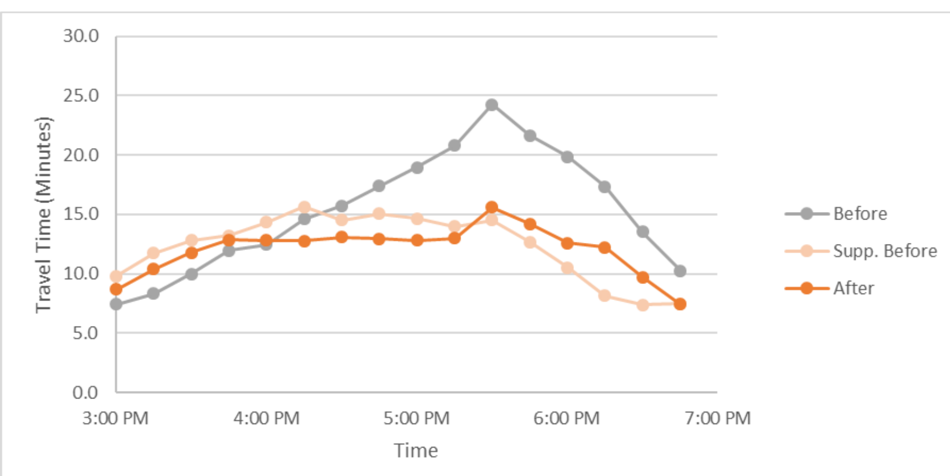
Data Source: INRIX, Floating car runs by Metro Traffic Data, Inc.

Table 14: General Purpose Lane Travel Times and Speeds, PM Peak Period, Northbound

	Travel Time (Minutes)			Speed (Miles per Hour)		
	GP Lanes	GP Lanes	GP Lanes	GP Lanes	GP Lanes	GP Lanes
Time	Before (2014)	Supp. Before (2017)	After (2018)	Before (2014)	Supp. Before (2017)	After (2018)
3:00 PM	7.4	9.8	8.7	66	50	57
3:15 PM	8.3	11.7	10.4	59	42	47
3:30 PM	10.0	12.8	11.8	50	38	41
3:45 PM	12.0	13.2	12.9	41	37	37
4:00 PM	12.4	14.3	12.8	40	34	37
4:15 PM	14.6	15.6	12.8	34	31	38
4:30 PM	15.7	14.5	13.1	31	34	37
4:45 PM	17.4	**15.1**	12.9	28	32	38
5:00 PM	18.9	14.6	12.8	26	33	38
5:15 PM	20.8	14.0	13.0	24	35	38
5:30 PM	**24.2**	14.5	**15.6**	20	34	31
5:45 PM	21.6	12.7	14.2	22	39	33
6:00 PM	19.9	10.5	12.6	24	47	38
6:15 PM	17.3	8.1	12.2	27	61	38
6:30 PM	13.5	7.4	9.7	36	67	50
6:45 PM	10.3	7.5	7.4	48	66	67

Notes:
Northbound from Bollinger Canyon Rd. On-Ramp to Livorna Rd. On-Ramp (8.3 miles)
Data Source: INRIX, Floating car runs by Metro Traffic Data, Inc.

Figure 10: General Purpose Lane Travel Times, PM Peak Period, Northbound



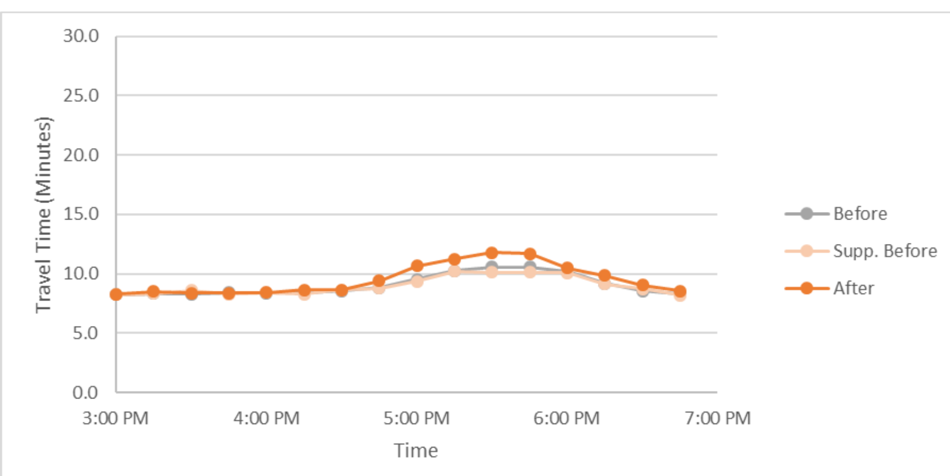
Data Source: INRIX, Floating car runs by Metro Traffic Data, Inc.

Table 15: General Purpose Lane Travel Times and Speeds, PM Peak Period, Southbound

	Travel Time (Minutes)			Speed (Miles per Hour)		
	GP Lanes	GP Lanes	GP Lanes	GP Lanes	GP Lanes	GP Lanes
Time	Before (2014)	Supp. Before (2017)	After (2018)	Before (2014)	Supp. Before (2017)	After (2018)
3:00 PM	8.2	8.3	8.3	67	66	66
3:15 PM	8.3	8.3	8.5	66	66	65
3:30 PM	8.3	8.6	8.4	66	63	65
3:45 PM	8.4	8.3	8.4	65	66	65
4:00 PM	8.4	8.4	8.4	65	65	65
4:15 PM	8.4	8.3	8.6	65	66	64
4:30 PM	8.5	8.6	8.6	64	63	64
4:45 PM	8.8	8.8	9.4	62	63	58
5:00 PM	9.5	9.3	10.6	57	59	51
5:15 PM	10.3	**10.2**	11.2	53	54	49
5:30 PM	**10.6**	10.1	**11.7**	52	54	46
5:45 PM	**10.6**	10.1	**11.7**	52	54	46
6:00 PM	10.2	10.0	10.5	54	54	52
6:15 PM	9.2	9.1	9.9	60	60	55
6:30 PM	8.6	8.7	9.0	64	63	60
6:45 PM	8.3	8.2	8.6	66	67	64

Notes:
Southbound from Rudgear Rd. On-Ramp to Bollinger Canyon Rd. Off-Ramp (9.1 miles)
Data Source: INRIX, Floating car runs by Metro Traffic Data, Inc.

Figure 11: General Purpose Lane Travel Times, PM Peak Period, Southbound



Data Source: INRIX, Floating car runs by Metro Traffic Data, Inc.

Travel Time Savings

Travel time savings in the HOV/Express lanes compared to the general purpose lanes are listed in Table 16 and Table 17.

In the northbound direction, the maximum travel time savings in the AM peak period increased from 2 to 3 minutes in the Before and Supplemental Before studies to maximum savings of 4 to 5 minutes in the After study. In the PM peak period, in the Before study, the HOV lane provided time savings of up to 40 percent (6 to 9 minutes) during the most congested hour, but much smaller time savings during other hours. In the After study, the express lanes consistently provided time savings of 30 to 40 percent (up to 6 minutes) throughout most of the PM peak period. This would indicate that more vehicles are benefiting from the time savings provided by the express lane.

Southbound travel time savings have stayed relatively constant in the AM peak period, with maximum savings of about 30 percent (4 minutes) in the managed lane compared to the general purpose lanes. Southbound travel time savings in the PM peak period have improved since the implementation of the express lanes, from maximum savings of 14 to 19 percent (1 to 2 minutes) in the Before and Supplemental Before studies to maximum time savings of 24 percent (3 minutes) in the After study.

In summary, travel time savings have generally stayed constant or improved after the implementation of express lanes.

Table 16: Express/HOV Lane Travel Time Savings, Northbound

Time	Before (2014)		Supp. Before (2017)		After (2018)	
	Time (Minutes)	Percent	Time (Minutes)	Percent	Time (Minutes)	Percent
5:00 AM	0.5	7%	0.9	12%	0.8	11%
5:15 AM	0.6	8%	0.7	9%	0.7	10%
5:30 AM	0.3	4%	1.0	13%	0.8	11%
5:45 AM	0.6	9%	1.1	14%	0.4	6%
6:00 AM	0.5	6%	0.8	10%	0.6	9%
6:15 AM	0.4	6%	0.8	10%	0.9	12%
6:30 AM	0.1	1%	0.6	8%	0.6	9%
6:45 AM	0.7	10%	0.5	6%	1.2	16%
7:00 AM	0.1	2%	0.5	7%	1.0	13%
7:15 AM	0.5	6%	0.0	0%	0.6	7%
7:30 AM	-0.9	-12%	0.6	7%	0.0	0%
7:45 AM	1.9	21%	1.1	12%	2.4	25%
8:00 AM	1.1	11%	1.5	15%	1.6	16%
8:15 AM	0.3	4%	**3.3**	**28%**	2.5	25%
8:30 AM	1.1	11%	2.7	23%	3.9	35%
8:45 AM	**2.6**	**26%**	2.4	21%	**4.5**	**39%**
3:00 PM	-0.6	-8%	0.4	4%	1.3	15%
3:15 PM	-0.5	-6%	2.2	19%	2.7	26%
3:30 PM	0.5	5%	2.8	22%	3.4	29%
3:45 PM	0.9	8%	2.1	16%	4.3	33%
4:00 PM	0.3	3%	2.5	17%	4.6	36%
4:15 PM	2.5	17%	4.4	28%	3.8	30%
4:30 PM	1.7	11%	2.7	19%	4.3	33%
4:45 PM	2.5	15%	3.4	23%	3.6	28%
5:00 PM	2.3	12%	**3.8**	**26%**	3.9	30%
5:15 PM	3.8	18%	3.4	24%	2.8	22%
5:30 PM	**8.9**	**37%**	3.7	25%	4.7	30%
5:45 PM	7.4	34%	2.4	19%	**6.0**	**42%**
6:00 PM	6.3	32%	2.1	20%	4.8	38%
6:15 PM	7.0	40%	0.6	7%	5.1	42%
6:30 PM	3.8	28%	0.2	3%	2.9	30%
6:45 PM	1.5	15%	0.5	7%	0.1	2%

Notes:
HOV lane ended operation at 9:00 AM.
Northbound from Bollinger Canyon Rd. On-Ramp to Livorna Rd. On-Ramp (8.3 miles)
Data Sources: Floating car runs by Metro Traffic Data, Inc., INRIX

Table 17: Express/HOV Lane Travel Time Savings, Southbound

	Before (2014)		Supp. Before (2017)		After (2018)	
Time	Time (Minutes)	Percent	Time (Minutes)	Percent	Time (Minutes)	Percent
5:00 AM	0.1	1%	0.5	7%	0.4	5%
5:15 AM	0.7	9%	0.3	4%	0.9	11%
5:30 AM	0.5	7%	0.7	9%	-0.1	-1%
5:45 AM	0.9	11%	0.3	3%	0.2	3%
6:00 AM	0.6	7%	0.4	5%	0.1	2%
6:15 AM	0.9	11%	0.8	9%	0.5	6%
6:30 AM	0.9	10%	0.2	2%	0.7	8%
6:45 AM	0.0	0%	1.5	15%	0.7	7%
7:00 AM	0.6	6%	2.0	19%	1.0	10%
7:15 AM	2.6	23%	2.4	21%	2.1	19%
7:30 AM	2.8	24%	2.7	24%	1.3	12%
7:45 AM	2.3	20%	3.0	23%	1.6	14%
8:00 AM	2.2	18%	2.3	20%	2.6	22%
8:15 AM	**3.6**	**29%**	**4.2**	**33%**	2.4	20%
8:30 AM	3.0	26%	3.3	26%	3.0	25%
8:45 AM	2.7	23%	3.6	27%	**3.6**	**30%**
3:00 PM	0.6	8%	0.8	9%	0.6	8%
3:15 PM	0.4	5%	0.6	7%	0.6	8%
3:30 PM	0.7	8%	1.2	13%	0.5	5%
3:45 PM	0.8	10%	0.5	6%	0.7	8%
4:00 PM	0.5	6%	0.8	10%	0.8	9%
4:15 PM	0.5	6%	0.5	7%	1.2	14%
4:30 PM	0.0	0%	1.1	12%	0.7	8%
4:45 PM	0.6	7%	0.5	6%	1.8	19%
5:00 PM	1.3	14%	1.1	12%	2.4	23%
5:15 PM	0.8	8%	1.8	17%	1.9	17%
5:30 PM	**1.5**	**14%**	1.4	14%	2.6	22%
5:45 PM	**1.5**	**14%**	1.3	13%	**2.9**	**24%**
6:00 PM	1.2	12%	**2.0**	**19%**	1.9	18%
6:15 PM	0.3	4%	1.5	16%	1.5	15%
6:30 PM	0.5	6%	1.3	15%	1.2	13%
6:45 PM	0.7	9%	0.2	3%	1.2	14%

Notes:
HOV lane ended operation at 9:00 AM.
Southbound from Rudgear Rd. On-Ramp to Bollinger Canyon Rd. Off-Ramp (9.1 miles)
Data Sources: Floating car runs by Metro Traffic Data, Inc., INRIX

Travel Speeds

Average speeds in the HOV/Express lanes and general purpose lanes are listed in Table 8 to Table 15 and summarized in Figure 12 to Figure 15.

HOV/Express Lanes

Average speeds in the HOV/Express lane are based on the floating car surveys, and therefore represent data from one to four days as opposed to a longer observation period.

In the AM peak period, speeds in the northbound HOV lane in the Before and Supplemental Before studies were above 60 mph in the earlier hours and dropped below 60 mph during the 8:00 to 9:00 AM hour. In the After study, northbound express lane speeds stayed above 60 mph throughout the AM peak period. In the southbound direction, AM peak period speeds were very similar between the Before, Supplemental Before and After studies.

Speeds in the PM peak period improved significantly in the northbound direction. During the Before study surveys, speeds below 35 mph were observed in the HOV lane for 1.5 hours. Speeds improved during the Supplemental Before study, but were still under 45 mph for more than an hour. The average speeds in the northbound express lane in the After study were higher than 45 mph throughout the PM peak period, and were higher than 55 mph for all but three 15-minute periods. As with the AM peak period, southbound PM peak period speeds in the managed lane were very similar during all three study periods.

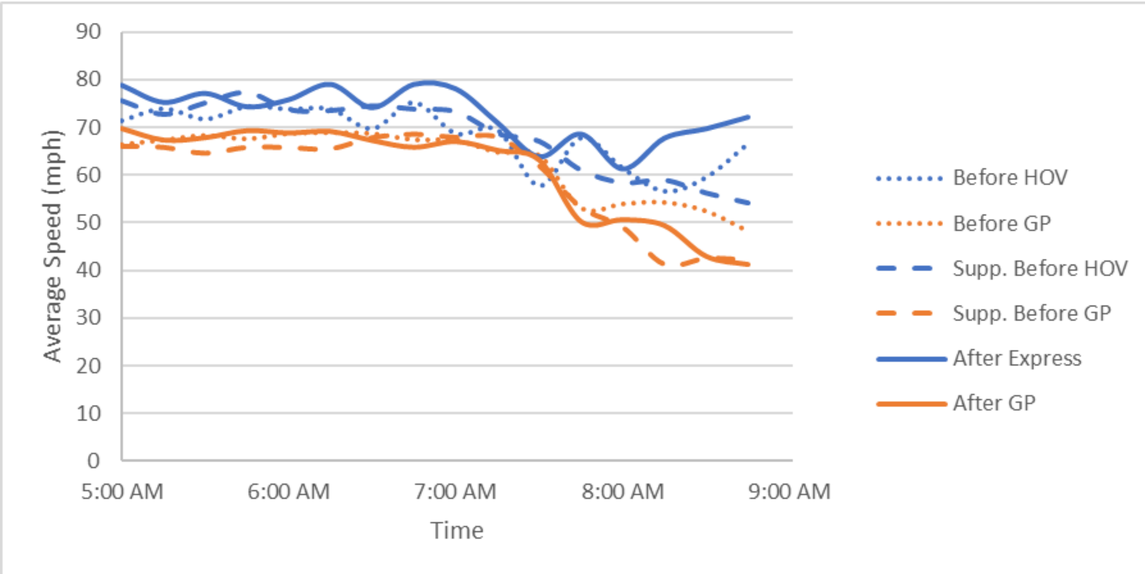
General Purpose Lanes

During the AM peak period, average speeds in the general purpose lanes were similar in the Before, Supplemental Before and After conditions. Northbound speeds during all three periods remained above 65 mph until 7:15 AM. Average speeds dropped to 48 mph in the Before study and to 41 mph in the Supplemental Before and After studies. Southbound speeds remained above 65 mph until 6:15 AM and were in the 40 to 50 mph range from 7:00 to 9:00 AM in all three study periods.

General purpose lane speeds for the most congested conditions, northbound during the PM peak period, improved after the implementation of the express lanes. During the before study, average speeds were below 35 mph for over two hours and dropped as low as 20 mph. The duration of speeds less than 35 mph was reduced to less than two hours in the Supplemental Before study and speeds were no less than 30 mph. After implementation of the express lanes, speeds less than 35 mph were observed for one-half hour. In the southbound direction, speeds remained above 45 mph throughout the PM peak period and were similar for all three study years.

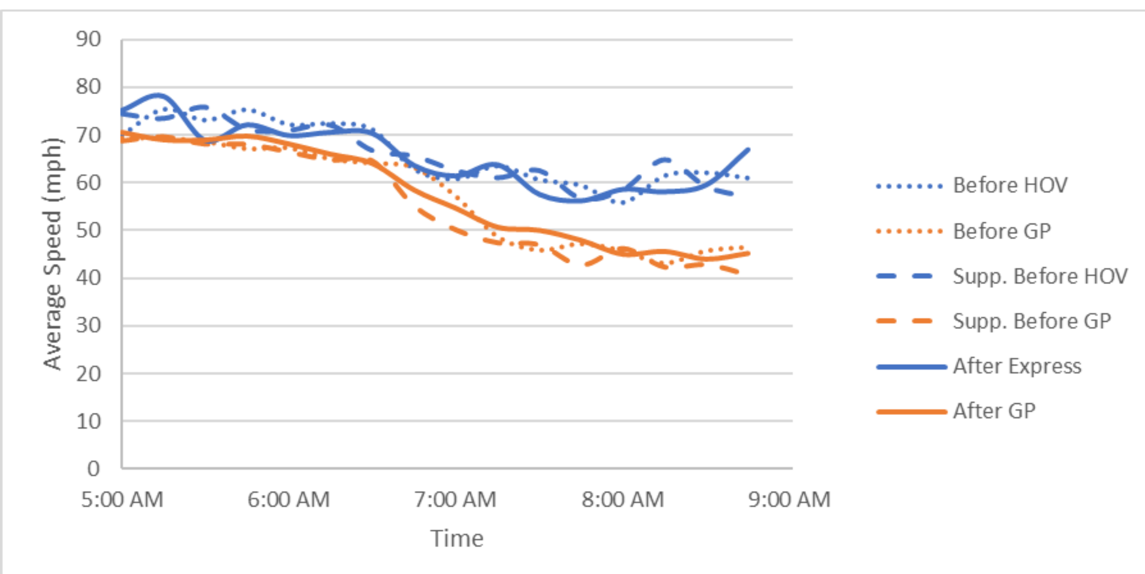
In summary, the slowest speed conditions all improved between the Before and After conditions, for both the HOV/Express and general purpose lanes.

Figure 12: Average Speeds, AM Peak Period, Northbound



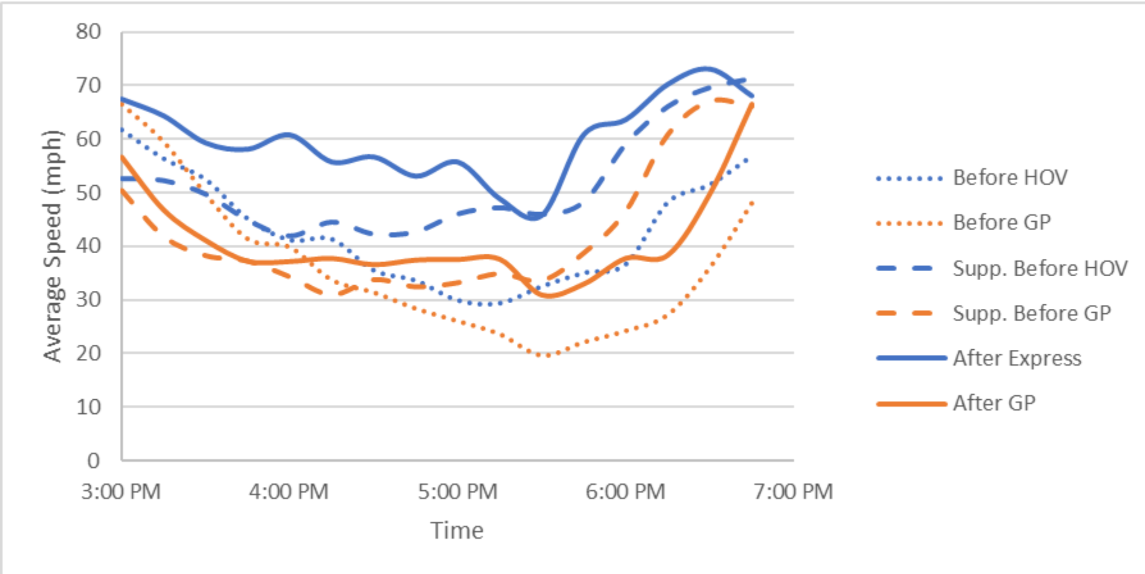
Notes:
HOV lane ended operation at 9:00 AM.
Northbound from Bollinger Canyon Rd. On-Ramp to Livorna Rd. On-Ramp (8.3 miles)
Data Sources: Floating car runs by Metro Traffic Data, Inc., INRIX

Figure 13: Average Speeds, AM Peak Period, Southbound



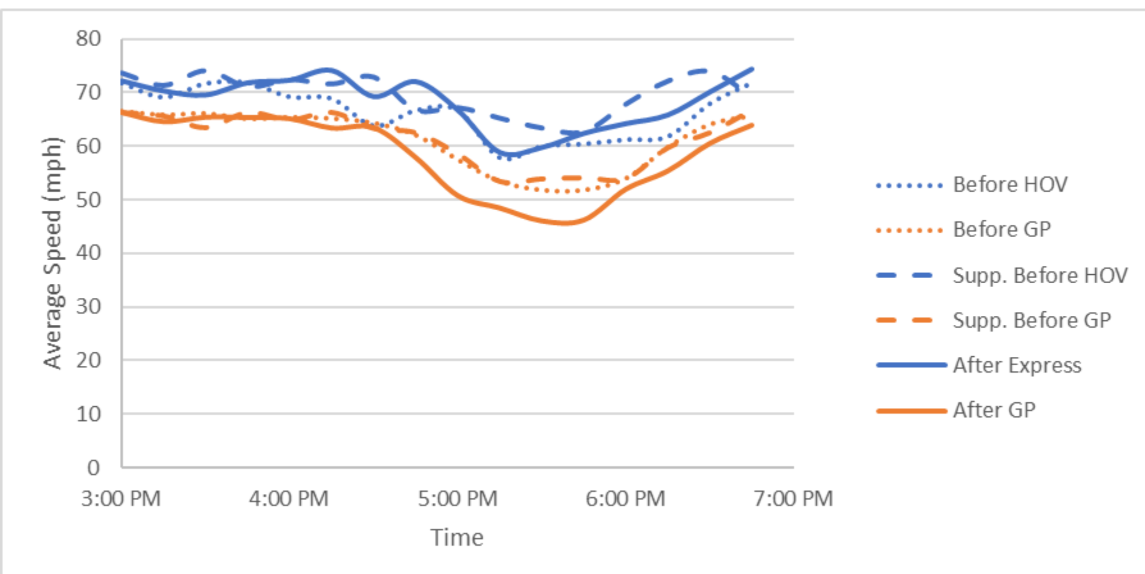
Notes:
HOV lane ended operation at 9:00 AM.
Southbound from Rudgear Rd. On-Ramp to Bollinger Canyon Rd. Off-Ramp (9.1 miles)
Data Sources: Floating car runs by Metro Traffic Data, Inc., INRIX

Figure 14: Average Speeds, PM Peak Period, Northbound



Notes:
Northbound from Bollinger Canyon Rd. On-Ramp to Livorna Rd. On-Ramp (8.3 miles)
Data Sources: Floating car runs by Metro Traffic Data, Inc., INRIX

Figure 15: Average Speeds, PM Peak Period, Southbound



Notes:
Southbound from Rudgear Rd. On-Ramp to Bollinger Canyon Rd. Off-Ramp (9.1 miles)
Data Sources: Floating car runs by Metro Traffic Data, Inc., INRIX

6.2. MEASURE 2: DELAY

Delay is measured as the difference between actual observed travel times and the free-flow travel times under uncongested conditions at 65 miles per hour. The I-680 study corridor delay compared to free flow time is shown for 15 minute intervals in Table 18 and Table 19.

HOV/Express Lanes

During the AM peak period, there was minimal delay on the HOV lanes in the Before study, with a maximum of 1.4 minutes in the southbound direction at 8:00 AM. The AM delays have stayed around 1.4 minutes or less in the After conditions.

The northbound HOV lane had significant delays of up to 9 minutes in the PM peak period in the Before study. These maximum northbound delays decreased to 4 minutes in the Supplemental Before study and 3 minutes in the express lane in the After study. In the southbound direction during the PM peak period, maximum delays have remained constant at 1 minute.

General Purpose Lanes

The general purpose lanes experience the highest delays northbound during the PM peak period. Maximum delays of 17 minutes were recorded during the Before study. The maximum delays decreased to around 7 to 8 minutes in the Supplemental Before and After studies. Maximum northbound delays during the AM peak period have increased slightly from around 3 minutes in the Before study to about 4 minutes in the After study. Maximum delays in the southbound direction have remained about 4 minutes in the AM peak period and increased slightly from 2 to 3 minutes in the PM peak period.

In summary, managed lane delays have decreased for the most congested conditions, northbound during the PM peak period, and have stayed at low values (maximum of about one minute) for both directions during the AM peak period and southbound during the PM peak period. General purpose lane delays have remained similar to the Supplemental Before conditions for most periods, and have increased slightly southbound during the PM peak period.

Table 18: Average Delay (Minutes), Northbound

		HOV/Express Lane			General Purpose Lanes		
Time	Free Flow Travel Time	Before (2014)	Supp. Before (2017)	After (2018)	Before (2014)	Supp. Before (2017)	After (2018)
5:00 AM	7.7	0.0	0.0	0.0	0.0	0.0	0.0
5:15 AM	7.7	0.0	0.0	0.0	0.0	0.0	0.0
5:30 AM	7.7	0.0	0.0	0.0	0.0	0.0	0.0
5:45 AM	7.7	0.0	0.0	0.0	0.0	0.0	0.0
6:00 AM	7.7	0.0	0.0	0.0	0.0	0.0	0.0
6:15 AM	7.7	0.0	0.0	0.0	0.0	0.0	0.0
6:30 AM	7.7	0.0	0.0	0.0	0.0	0.0	0.0
6:45 AM	7.7	0.0	0.0	0.0	0.0	0.0	0.0
7:00 AM	7.7	0.0	0.0	0.0	0.0	0.0	0.0
7:15 AM	7.7	0.0	0.0	0.0	0.0	0.0	0.0
7:30 AM	7.7	1.0	0.0	0.1	0.0	0.3	0.2
7:45 AM	7.7	0.0	0.5	0.0	1.6	1.6	2.0
8:00 AM	7.7	0.4	0.8	**0.5**	1.5	2.4	2.0
8:15 AM	7.7	**1.1**	0.8	0.0	1.5	**4.1**	2.2
8:30 AM	7.7	0.7	1.2	0.0	1.8	3.8	3.4
8:45 AM	7.7	0.0	**1.5**	0.0	**2.5**	3.9	**3.7**
3:00 PM	7.7	0.4	1.8	0.0	0.0	2.2	1.0
3:15 PM	7.7	1.2	1.9	0.1	0.7	4.1	2.7
3:30 PM	7.7	1.8	2.4	0.7	2.3	5.1	4.1
3:45 PM	7.7	3.4	3.4	0.9	4.3	5.5	5.2
4:00 PM	7.7	4.4	**4.2**	0.5	4.8	6.7	5.1
4:15 PM	7.7	4.4	3.5	1.3	6.9	8.0	5.1
4:30 PM	7.7	6.4	4.1	1.1	8.1	6.9	5.4
4:45 PM	7.7	7.2	4.0	1.7	9.7	**7.4**	5.3
5:00 PM	7.7	9.0	3.2	1.3	11.3	7.0	5.2
5:15 PM	7.7	**9.3**	2.9	2.5	13.1	6.3	5.3
5:30 PM	7.7	7.7	3.2	**3.2**	**16.6**	6.8	**7.9**
5:45 PM	7.7	6.6	2.6	0.5	14.0	5.0	6.5
6:00 PM	7.7	5.9	0.8	0.2	12.2	2.9	4.9
6:15 PM	7.7	2.7	0.0	0.0	9.7	0.5	4.6
6:30 PM	7.7	2.0	0.0	0.0	5.9	0.0	2.1
6:45 PM	7.7	1.1	0.0	0.0	2.6	0.0	0.0

Northbound from Bollinger Canyon Rd. On-Ramp to Livorna Rd. On-Ramp (8.3 miles)
Free flow travel time is equal to travel time at 65 mph.
Delay is the difference between average travel time and free flow travel time, floored at zero.
Data Sources: Floating car runs by Metro Traffic Data, Inc., INRIX

Table 19: Average Delay (Minutes), Southbound

		HOV/Express Lane			General Purpose Lanes		
Time	Free Flow Travel Time	Before (2014)	Supp. Before (2017)	After (2018)	Before (2014)	Supp. Before (2017)	After (2018)
5:00 AM	8.4	0.0	0.0	0.0	0.0	0.0	0.0
5:15 AM	8.4	0.0	0.0	0.0	0.0	0.0	0.0
5:30 AM	8.4	0.0	0.0	0.0	0.0	0.0	0.0
5:45 AM	8.4	0.0	0.0	0.0	0.0	0.0	0.0
6:00 AM	8.4	0.0	0.0	0.0	0.0	0.0	0.0
6:15 AM	8.4	0.0	0.0	0.0	0.0	0.0	0.0
6:30 AM	8.4	0.0	0.0	0.0	0.2	0.1	0.1
6:45 AM	8.4	0.3	0.0	0.3	0.3	1.5	1.0
7:00 AM	8.4	0.6	0.4	0.6	1.2	2.5	1.6
7:15 AM	8.4	0.2	0.7	0.3	2.8	3.1	2.3
7:30 AM	8.4	0.6	0.4	1.2	3.4	3.2	2.5
7:45 AM	8.4	0.8	**1.3**	**1.4**	3.1	4.3	3.0
8:00 AM	8.4	**1.4**	1.0	1.0	3.5	3.4	3.7
8:15 AM	8.4	0.5	0.1	1.1	**4.1**	4.3	3.5
8:30 AM	8.4	0.4	0.9	0.9	3.4	4.3	**3.9**
8:45 AM	8.4	0.6	**1.3**	0.0	3.3	**4.9**	3.4
3:00 PM	8.4	0.0	0.0	0.0	0.0	0.0	0.0
3:15 PM	8.4	0.0	0.0	0.0	0.0	0.0	0.1
3:30 PM	8.4	0.0	0.0	0.0	0.0	0.2	0.0
3:45 PM	8.4	0.0	0.0	0.0	0.0	0.0	0.0
4:00 PM	8.4	0.0	0.0	0.0	0.0	0.0	0.0
4:15 PM	8.4	0.0	0.0	0.0	0.0	0.0	0.2
4:30 PM	8.4	0.2	0.0	0.0	0.1	0.2	0.2
4:45 PM	8.4	0.0	0.0	0.0	0.4	0.4	1.0
5:00 PM	8.4	0.0	0.0	0.0	1.1	0.9	2.3
5:15 PM	8.4	**1.0**	0.1	**1.0**	1.9	**1.8**	2.8
5:30 PM	8.4	0.7	0.3	0.8	**2.2**	1.7	**3.4**
5:45 PM	8.4	0.6	**0.4**	0.4	**2.2**	1.7	3.3
6:00 PM	8.4	0.5	0.0	0.2	1.8	1.7	2.1
6:15 PM	8.4	0.4	0.0	0.0	0.8	0.7	1.5
6:30 PM	8.4	0.0	0.0	0.0	0.2	0.3	0.6
6:45 PM	8.4	0.0	0.0	0.0	0.0	0.0	0.2

Southbound from Rudgear Rd. On-Ramp to Bollinger Canyon Rd. Off-Ramp (9.1 miles)
Free flow travel time is equal to travel time at 65 mph.
Delay is the difference between average travel time and free flow travel time, floored at zero.
Data Sources: Floating car runs by Metro Traffic Data, Inc., INRIX

6.3. MEASURE 3: BOTTLENECKS, QUEUES AND DURATION

A bottleneck is a section of freeway where traffic demand exceeds its capacity. When traffic demand exceeds the capacity of a bottleneck, vehicle queues form upstream of the bottleneck. The evaluation of bottlenecks and queues identifies the locations of bottlenecks and the length and approximate duration of queues. The bottlenecks and queues were identified using the floating car travel time surveys, using a speed of 35 miles per hour or less as an indication of traffic operating in queues.

HOV/Express Lane Congestion Locations

Congested speeds corresponding to operation in queue (less than 35 miles per hour, a lower threshold than the 45 mph used to indicate degraded managed lane operations) were observed at times in the HOV or express lanes. The determination of congestion in the HOV/Express lanes was based on the floating car surveys, and represents a very limited sample of days of operation. Congestion in the HOV/Express lanes was observed to be primarily caused by friction from congested operations in the adjacent general purpose lanes, and was not observed to be caused by bottlenecks due to volumes exceeding capacity in the HOV lane.

The queues and congestion duration observed in the HOV/Express lanes are listed in Table 20 and displayed in Figure 16.

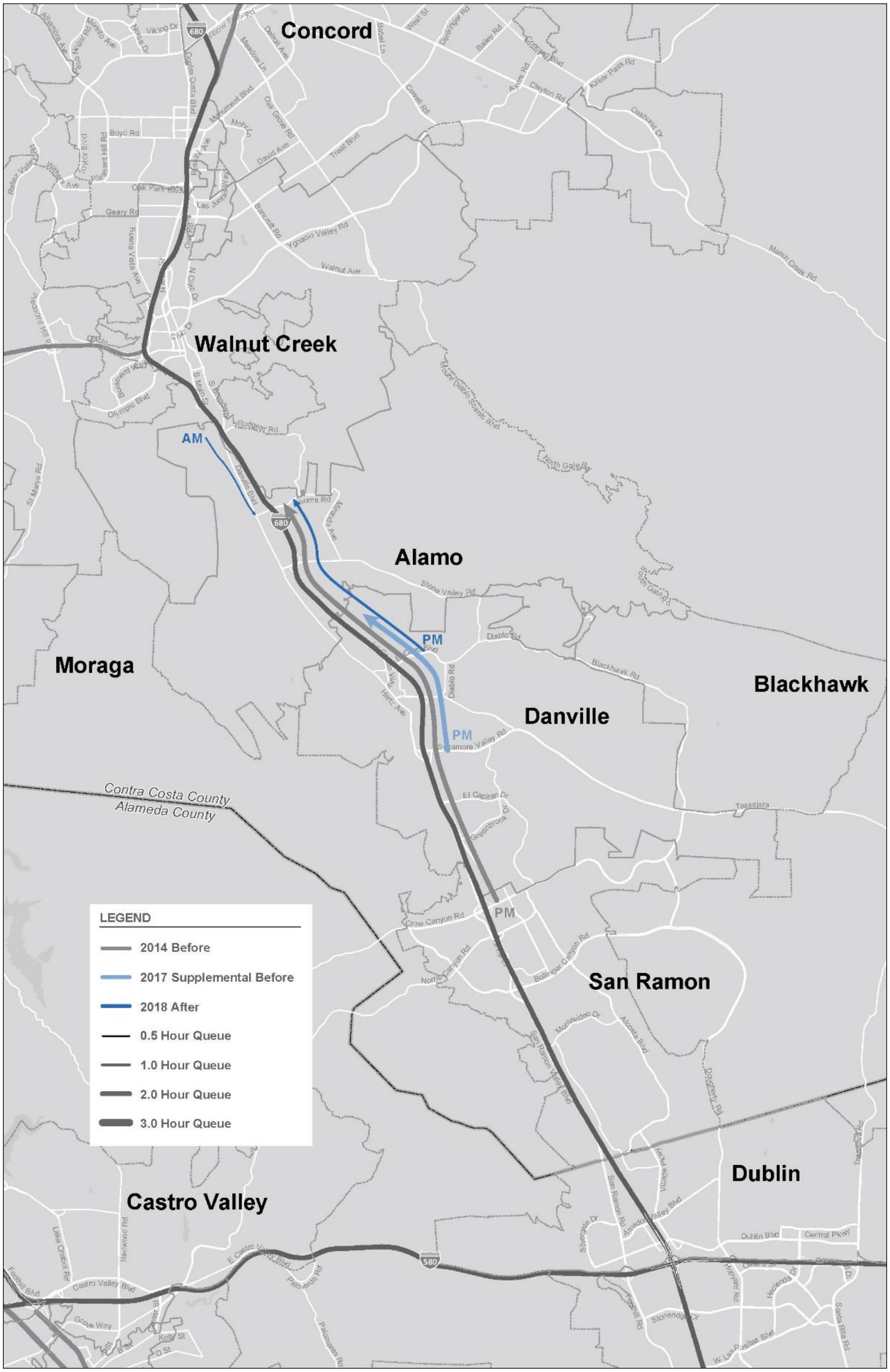
Table 20: Congestion Locations and Duration, HOV/Express Lanes

Time and Direction	Before (2014)	Supp. Before (2017)	After (2018)
AM PEAK PERIOD			
Northbound	None	None	None
Southbound	None	None	Rudgear to Livorna 0.7 miles 0.5 hours
PM PEAK PERIOD			
Northbound	Crow Canyon to Livorna 7.0 miles 2.0 hours	Sycamore to El Pintado 2.4 miles 2.0 hours	El Cerro to Livorna 3.4 miles 1.0 hours
Southbound	None	None	None

Data Source: Floating car runs by Metro Traffic Data, Inc.

During the AM peak period, there were no significant queues reported in the HOV lanes. In the After study, there were queues in the southbound express lane from Rudgear Road to Livorna Road during the peak 0.5 hours of the AM peak period. As shown in Table 22 on page 53, southbound AM peak period vehicle volumes in the managed lane increased by about 28 percent between the Before and After studies, which could contribute to the observed congestion.

Figure 16: Managed Lane Queues



The PM peak period had a 7 mile queue for 2 hours in the northbound HOV lane during the peak period in the Before study. That queuing had shortened to 2.4 miles in the 2017 Supplemental Before study. In the After study, the northbound PM queue had lengthened to 3.4 miles but the duration decreased to one hour.

General Purpose Lanes Bottlenecks and Queues

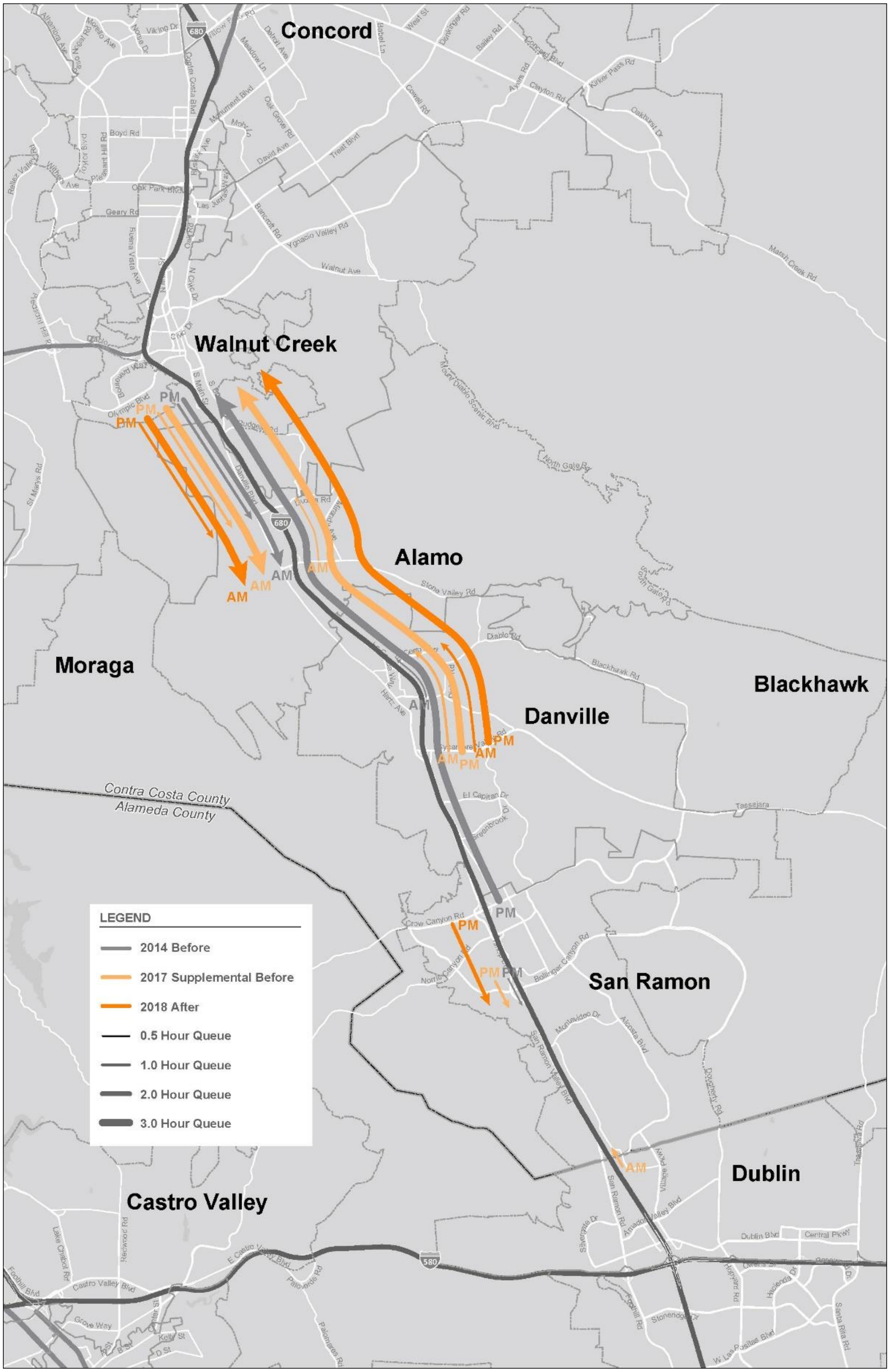
The queues and bottleneck locations in the general purpose lanes are summarized in Table 21 and displayed in Figure 17.

Table 21: Bottleneck and Queue Locations, Lengths and Durations, General Purpose Lanes

Time and Direction	Before (2014)	Supp. Before (2017)	After (2018)
AM PEAK PERIOD			
Northbound		Alcosta Off to On 0.5 miles 1.0 hours	
	Diablo to El Cerro 0.5 miles 0.5 hours	Sycamore Valley to El Cerro 2.5 miles 1.0 hours	Sycamore Valley to El Cerro 2.5 miles 1.0 hours
		Stone Valley to Livorna 1.0 miles 0.5 hours	
Southbound	S. Main to Stone Valley 2.7 miles 2.0 hours	S. Main to Stone Valley 3.3 miles 3.0 hours	S. Main to Stone Valley 2.7 miles 3.0 hours
PM PEAK PERIOD			
Northbound	Crow Canyon to S. Main 8.5 miles 3.0 hours	Sycamore Valley to S. Main 7.2 miles 3.0 hours	Sycamore Valley to S. Main 6.7 miles 3.0 hours
Southbound	S. Main to Livorna 1.8 miles 1.0 hours	S. Main to Livorna 1.6 miles 1.0 hours	S. Main to Livorna 1.8 miles 1.0 hours
	Bollinger Canyon Off to On 0.5 miles 0.5 hours	Bollinger Canyon Off to On 0.5 miles 1.0 hours	Crow Canyon to Bollinger Canyon 1.4 miles 1.5 hours

Data Source: INRIX

Figure 17: General Purpose Lane Queues



In the Before study, the most severe queues on the I-680 study corridor occurred in the northbound direction during the PM peak period. These queues originated from a bottleneck location north of the study corridor between the Lawrence Way on-ramp and the Treat Boulevard off-ramp, and extended 11 miles upstream through the SR 24 interchange into the study corridor as far south as the Crow Canyon Road interchange. In the Supplemental Before and After studies, this PM peak period queue was shorter by one to two miles.

The Supplemental Before study identified queues in the northbound direction at Alcosta Boulevard and Livorna Road in the AM peak period. These queues did not appear in the Before or After studies.

Additional bottlenecks were identified in the southbound direction:

- Stone Valley Road in the AM peak period, with queues of around three miles during all study scenarios
- Livorna Road in the PM peak period, with queues of 1.6 to 1.8 miles during all study scenarios
- Bollinger Canyon Road in the PM peak period, with a queue within the interchange in the Before and Supplemental Before studies, but extending 1.4 miles to Crow Canyon Road in the After study

The implementation of the express lanes did not appear to significantly shorten or lengthen queues in the general purpose lanes.

Duration of Congestion

HOV/Express Lanes

On the HOV/Express lanes, the duration of the northbound PM queue at Livorna Road decreased from 2 to 1 hours after implementation of the express lanes.

General Purpose Lanes

The duration of the northbound PM queue in the general purpose lanes in the north part of the study corridor has remained at 3 hours through the Before, Supplemental before and After studies. The duration of the southbound AM queue at Stone Valley Road increased from 2 to 3 hours from the Before to Supplemental Before studies, and remained at 3 hours in the After study. The southbound PM queue at Livorna Road has remained at 1 hour through all three study scenarios, while the duration of the southbound queue at Bollinger Canyon Road has increased from 0.5 to 1.5 hours.

6.4. MEASURE 4: VEHICLE OCCUPANCY AND CLASSIFICATION

Average Vehicle Occupancy

Vehicle occupancy is reported at each of the seven manual vehicle occupancy survey locations. The vehicle occupancy is reported only for the hours when occupancies could be reliably observed and HOV lanes were in operation during the Before conditions (7:00 to 9:00 AM and 3:00 to 5:00 PM). Average vehicle occupancies (AVO) for the AM and PM peak periods are summarized in Table 22 and Table 23.

In all locations, the AVOs in the managed lane decreased from values of 1.9 or more in the HOV lane to values of less than 1.8 after implementation of the express lane. In nearly all locations, the AVOs in the general purpose lane increased after implementation of the express lane. During both the AM and PM peak periods, the total AVO for all lanes increased at one location, stayed constant at two locations and decreased at four out of seven locations.

It is expected that average vehicle occupancies could decrease with implementation of an express lane, as additional vehicle capacity is provided for toll-paying single-occupant vehicles. However, the person throughput capacity of a freeway corridor can still increase even if AVOs decrease. Person throughput is discussed in more detail Section 6.6.

Table 22: Throughput and Average Vehicle Occupancies, AM Peak Period (7:00 to 9:00 AM)

Location & Lane Type	Vehicle Throughput		Person Throughput		Average Vehicle Occupancy	
	Before (2014)	After (2018)	Before (2014)	After (2018)	Before (2014)	After (2018)
NORTHBOUND						
Alcosta Boulevard						
HOV/Express	1,080	1,600	2,350	2,290	2.18	1.43
General Purpose	9,730	8,740	10,650	9,790	1.09	1.12
Total	**10,810**	**10,340**	**13,000**	**12,080**	**1.20**	**1.17**
Bollinger Canyon Road						
HOV/Express	990	1,450	1,910	2,190	1.93	1.51
General Purpose	7,170	7,420	8,040	8,440	1.12	1.14
Total	**8,160**	**8,870**	**9,950**	**10,630**	**1.22**	**1.20**
Crow Canyon Road						
HOV/Express	1,160	1,590	2,340	2,700	2.02	1.70
General Purpose	7,350	7,300	8,350	9,250	1.14	1.27
Total	**8,510**	**8,890**	**10,690**	**11,950**	**1.26**	**1.34**
Greenbrook Drive						
HOV/Express	1,830	2,240	4,200	3,920	2.30	1.75
General Purpose	8,000	8,850	9,180	10,550	1.15	1.19
Total	**9,830**	**11,090**	**13,380**	**14,470**	**1.36**	**1.30**
SOUTHBOUND						
Sycamore Valley Road						
HOV/Express	1,930	2,480	3,940	4,110	2.04	1.66
General Purpose	10,250	9,280	11,210	10,930	1.09	1.18
Total	**12,180**	**11,760**	**15,150**	**15,040**	**1.24**	**1.28**
Greenbrook Drive						
HOV/Express	1,280	1,640	2,850	2,700	2.23	1.65
General Purpose	8,440	8,030	10,430	9,360	1.24	1.17
Total	**9,720**	**9,670**	**13,280**	**12,060**	**1.37**	**1.25**
Norris Canyon Road						
HOV/Express	1,280	1,640	2,500	2,420	1.95	1.48
General Purpose	10,620	10,320	12,410	12,580	1.17	1.22
Total	**11,900**	**11,960**	**14,910**	**15,000**	**1.25**	**1.25**

Data Sources: Manual vehicle occupancy counts by Quality Counts LLC, Caltrans PeMS

Table 23: Throughput and Average Vehicle Occupancies, PM Peak Period (3:00 to 5:00 PM)

Location & Lane Type	Vehicle Throughput		Person Throughput		Average Vehicle Occupancy	
	Before (2014)	After (2018)	Before (2014)	After (2018)	Before (2014)	After (2018)
NORTHBOUND						
Alcosta Boulevard						
HOV/Express	1,280	1,030	2,840	1,620	2.22	1.57
General Purpose	9,640	7,540	11,280	8,860	1.17	1.18
Total	**10,920**	**8,570**	**14,120**	**10,480**	**1.29**	**1.22**
Bollinger Canyon Road						
HOV/Express	1,550	1,330	3,300	2,000	2.13	1.50
General Purpose	8,050	7,420	9,190	8,890	1.14	1.20
Total	**9,600**	**8,750**	**12,490**	**10,890**	**1.30**	**1.24**
Crow Canyon Road						
HOV/Express	1,850	1,570	4,000	2,700	2.16	1.72
General Purpose	8,070	7,350	9,660	9,440	1.20	1.28
Total	**9,920**	**8,920**	**13,660**	**12,140**	**1.38**	**1.36**
Greenbrook Drive						
HOV/Express	2,160	2,400	4,560	4,230	2.11	1.76
General Purpose	8,140	9,240	9,340	11,430	1.15	1.24
Total	**10,300**	**11,640**	**13,900**	**15,660**	**1.35**	**1.35**
SOUTHBOUND						
Sycamore Valley Road						
HOV/Express	1,720	1,880	3,450	2,960	2.01	1.57
General Purpose	8,670	8,330	10,170	10,240	1.17	1.23
Total	**10,390**	**10,210**	**13,620**	**13,200**	**1.31**	**1.29**
Greenbrook Drive						
HOV/Express	1,300	1,400	2,700	2,220	2.08	1.59
General Purpose	7,520	7,550	9,000	9,700	1.20	1.28
Total	**8,820**	**8,950**	**11,700**	**11,920**	**1.33**	**1.33**
Norris Canyon Road						
HOV/Express	1,300	1,620	3,130	2,810	2.41	1.73
General Purpose	9,980	10,010	12,380	12,640	1.24	1.26
Total	**11,280**	**11,630**	**15,510**	**15,450**	**1.38**	**1.33**

Data Sources: Manual vehicle occupancy counts by Quality Counts LLC, Caltrans PeMS

Vehicle Classifications

The detailed vehicle classifications for the four northbound and three southbound survey locations are shown in Table 24 through Table 30. The tables also include the percentages of clean air vehicles (CAVs) observed in the express lanes in the After study (CAVs were not specifically counted in the Before study) and the estimated percentages of vehicles eligible to use the HOV lane (in the Before study, excluding potential CAVs) or eligible to use the express lane without a toll requirement in the After study.

Table 24: Vehicle Classification Surveys, I-680 Northbound at Alcosta Boulevard

	HOV Lane	Express Lane	GP Lanes	GP Lanes	All Lanes	All Lanes
	Before (2014)	After (2018)	Before (2014)	After (2018)	Before (2014)	After (2018)
AM PEAK PERIOD (7:00 – 9:00 AM)						
SOV	23%	73%	89%	82%	80%	78%
HOV 2	67	21	4	5	12	11
HOV 3+	4	2	<1	<1	1	1
Motorcycles	2	1	<1	<1	<1	<1
Heavy Vehicles	3	3	7	13	6	9
Buses	1	<1	<1	<1	<1	<1
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Clean Air Vehicles	n/a	8%	n/a	n/a	n/a	n/a
HOV Eligible[1]	74%[2]	32%				
PM PEAK PERIOD (3:00 – 5:00 PM)						
SOV	15%	59%	85%	83%	76%	76%
HOV 2	71	27	11	12	19	16
HOV 3+	9	8	1	1	2	3
Motorcycles	3	4	<1	<1	1	1
Heavy Vehicles	1	2	3	4	2	3
Buses	1	<1	<1	<1	<1	<1
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Clean Air Vehicles	n/a	6%	n/a	n/a	n/a	n/a
HOV Eligible[1]	84%[2]	45%				

[1]Sum of HOV 2, HOV3+, Motorcycles, Buses, Clean Air Vehicles
[2]Not including Clean Air Vehicles
Data Source: Manual vehicle occupancy counts by Quality Counts LLC

In the Before study, the vehicle occupancy counts in the HOV lanes reported percentages of single-occupancy vehicles (SOVs) ranging from 7 percent to as high as 36 percent. Typical values were around 20 percent SOV in the HOV lane. The SOVs could be vehicles with valid clean air vehicle (CAV) stickers (white or green), or they could be in violation of the vehicle occupancy requirements. The percentages of vehicles with CAV stickers were unknown during the Before study, but were surveyed as typically around five percent during the After study.

Table 25: Vehicle Classification Surveys, I-680 Northbound at Bollinger Canyon Road

	HOV Lane	Express Lane	GP Lanes	GP Lanes	All Lanes	All Lanes
	Before (2014)	After (2018)	Before (2014)	After (2018)	Before (2014)	After (2018)
AM PEAK PERIOD (7:00 – 9:00 AM)						
SOV	30%	74%	87%	84%	79%	81%
HOV 2	61	21	3	7	12	12
HOV 3+	3	1	1	<1	1	<1
Motorcycles	1	1	<1	<1	<1	<1
Heavy Vehicles	4	2	9	8	8	6
Buses	1	1	<1	<1	<1	<1
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Clean Air Vehicles	n/a	8%	n/a	n/a	n/a	n/a
HOV Eligible[1]	66%[2]	32%				
PM PEAK PERIOD (3:00 – 5:00 PM)						
SOV	12%	66%	87%	81%	74%	76%
HOV 2	75	28	8	13	20	18
HOV 3+	9	2	1	1	2	1
Motorcycles	3	3	<1	<1	1	1
Heavy Vehicles	1	0	4	5	3	3
Buses	<1	1	<1	<1	<1	<1
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Clean Air Vehicles	n/a	6%	n/a	n/a	n/a	n/a
HOV Eligible[1]	87%[2]	40%				

[1]Sum of HOV 2, HOV3+, Motorcycles, Buses, Clean Air Vehicles
[2]Not including Clean Air Vehicles
Data Source: Manual vehicle occupancy counts by Quality Counts LLC

The conversion of the HOV lane to an express lane allowed for a significant increase of SOVs in the managed lanes, up to 74 percent at Bollinger Canyon Road in the AM peak period. However, there were typically simultaneous decreases in the SOV percentages in the general purpose lanes. The results for the total lanes are the best indication of overall changes in ridesharing. Of the 14 total locations and time periods surveyed, there were overall decreases in SOV percentages at 9 locations, increases in SOV percentages at 3 locations and no change at 2 locations. Therefore, the implementation of express lanes did not generally result in increases in the percentages of SOVs on the study corridor.

Table 26: Vehicle Classification Surveys, I-680 Northbound at Crow Canyon Road

	HOV Lane	Express Lane	GP Lanes	GP Lanes	All Lanes	All Lanes
	Before (2014)	After (2018)	Before (2014)	After (2018)	Before (2014)	After (2018)
AM PEAK PERIOD (7:00 – 9:00 AM)						
SOV	36%	67%	84%	85%	75%	78%
HOV 2	57	25	4	8	13	15
HOV 3+	1	4	<1	<1	<1	2
Motorcycles	1	1	<1	<1	<1	<1
Heavy Vehicles	4	2	12	6	10	4
Buses	1	1	<1	1	<1	1
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Clean Air Vehicles	n/a	7%	n/a	n/a	n/a	n/a
HOV Eligible[1]	60%[2]	38%				
PM PEAK PERIOD (3:00 – 5:00 PM)						
SOV	20%	58%	89%	83%	74%	73%
HOV 2	69	33	7	12	20	20
HOV 3+	6	4	<1	<1	2	2
Motorcycles	3	2	<1	<1	1	1
Heavy Vehicles	1	2	4	4	3	3
Buses	1	1	<1	<1	<1	1
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Clean Air Vehicles	n/a	5%	n/a	n/a	n/a	n/a
HOV Eligible[1]	79%[2]	45%				

[1]Sum of HOV 2, HOV3+, Motorcycles, Buses, Clean Air Vehicles
[2]Not including Clean Air Vehicles
Data Source: Manual vehicle occupancy counts by Quality Counts LLC

The tables also list the percentages of vehicles which could be eligible to use the HOV lane or to use the express lane without payment. These include vehicles in the HOV 2, HOV 3+, Motorcycle, Bus or Clean Air Vehicle categories. The percentages for the Before study will underestimate the percentages of "HOV eligible" vehicles, as the clean air vehicles were not counted during that study. With that qualification, the average percentage of HOV eligible vehicles in the HOV lane during the Before study was 75 percent. The average percentage of HOV eligible vehicles in the express lane during the After study, including consideration of clean air vehicles (assumed to be mostly single-occupant) was 41 percent.

Table 27: Vehicle Classification Surveys, I-680 Northbound at Greenbrook Road

	HOV Lane	Express Lane	GP Lanes	GP Lanes	All Lanes	All Lanes
	Before (2014)	After (2018)	Before (2014)	After (2018)	Before (2014)	After (2018)
AM PEAK PERIOD (7:00 – 9:00 AM)						
SOV	7%	52%	89%	85%	76%	72%
HOV 2	87	43	4	7	17	21
HOV 3+	1	1	<1	<1	<1	1
Motorcycles	2	<1	<1	<1	<1	<1
Heavy Vehicles	2	3	7	8	6	6
Buses	1	1	<1	<1	<1	<1
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Clean Air Vehicles	n/a	5%	n/a	n/a	n/a	n/a
HOV Eligible[1]	91%[2]	50%				
PM PEAK PERIOD (3:00 – 5:00 PM)						
SOV	20%	63%	91%	85%	78%	77%
HOV 2	69	30	5	10	17	17
HOV 3+	7	1	<1	<1	2	1
Motorcycles	2	2	<1	<1	<1	1
Heavy Vehicles	1	2	3	5	3	3
Buses	1	2	<1	<1	<1	1
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Clean Air Vehicles	n/a	6%	n/a	n/a	n/a	n/a
HOV Eligible[1]	79%[2]	41%				

[1]Sum of HOV 2, HOV3+, Motorcycles, Buses, Clean Air Vehicles
[2]Not including Clean Air Vehicles
Data Source: Manual vehicle occupancy counts by Quality Counts LLC

Table 28: Vehicle Classification Surveys, I-680 Southbound at Sycamore Valley Road

	HOV Lane	Express Lane	GP Lanes	GP Lanes	All Lanes	All Lanes
	Before (2014)	After (2018)	Before (2014)	After (2018)	Before (2014)	After (2018)
AM PEAK PERIOD (7:00 – 9:00 AM)						
SOV	35%	62%	94%	90%	84%	78%
HOV 2	59	34	2	6	12	18
HOV 3+	1	<1	<1	<1	<1	<1
Motorcycles	4	1	<1	<1	1	1
Heavy Vehicles	<1	2	4	4	3	3
Buses	1	1	<1	<1	<1	<1
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Clean Air Vehicles	n/a	4%	n/a	n/a	n/a	n/a
HOV Eligible[1]	65%[2]	40%				
PM PEAK PERIOD (3:00 – 5:00 PM)						
SOV	24%	54%	84%	80%	75%	71%
HOV 2	70	41	10	13	19	23
HOV 3+	3	1	1	<1	1	<1
Motorcycles	1	<1	<1	<1	<1	<1
Heavy Vehicles	1	3	5	6	4	5
Buses	1	1	<1	<1	<1	<1
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Clean Air Vehicles	n/a	3%	n/a	n/a	n/a	n/a
HOV Eligible[1]	75%[2]	46%				

[1]Sum of HOV 2, HOV3+, Motorcycles, Buses, Clean Air Vehicles
[2]Not including Clean Air Vehicles
Data Source: Manual vehicle occupancy counts by Quality Counts LLC

Table 29: Vehicle Classification Surveys, I-680 Southbound at Greenbrook Road

	HOV Lane	Express Lane	GP Lanes	GP Lanes	All Lanes	All Lanes
	Before (2014)	After (2018)	Before (2014)	After (2018)	Before (2014)	After (2018)
AM PEAK PERIOD (7:00 – 9:00 AM)						
SOV	23%	58%	89%	90%	80%	78%
HOV 2	68	35	6	6	14	17
HOV 3+	2	1	1	<1	1	1
Motorcycles	5	2	<1	<1	1	1
Heavy Vehicles	1	3	4	4	3	3
Buses	1	1	<1	<1	1	<1
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Clean Air Vehicles	n/a	3%	n/a	n/a	n/a	n/a
HOV Eligible[1]	76%[2]	42%				
PM PEAK PERIOD (3:00 – 5:00 PM)						
SOV	17%	57%	83%	83%	74%	74%
HOV 2	73	39	12	12	20	20
HOV 3+	7	2	<1	<1	1	1
Motorcycles	2	1	<1	<1	<1	<1
Heavy Vehicles	1	2	5	5	4	4
Buses	<1	1	<1	<1	<1	<1
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Clean Air Vehicles	n/a	5%	n/a	n/a	n/a	n/a
HOV Eligible[1]	82%[2]	48%				

[1]Sum of HOV 2, HOV3+, Motorcycles, Buses, Clean Air Vehicles
[2]Not including Clean Air Vehicles
Data Source: Manual vehicle occupancy counts by Quality Counts LLC

Table 30: Vehicle Classification Surveys, I-680 Southbound at Norris Canyon Road

	HOV Lane	Express Lane	GP Lanes	GP Lanes	All Lanes	All Lanes
	Before (2014)	After (2018)	Before (2014)	After (2018)	Before (2014)	After (2018)
AM PEAK PERIOD (7:00 – 9:00 AM)						
SOV	34%	73%	89%	85%	83%	81%
HOV 2	52	24	6	9	11	13
HOV 3+	2	<1	<1	<1	1	<1
Motorcycles	5	2	<1	<1	1	1
Heavy Vehicles	6	<1	4	6	4	4
Buses	1	1	<1	<1	<1	1
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Clean Air Vehicles	n/a	7%	n/a	n/a	n/a	n/a
HOV Eligible[1]	60%[2]	34%				
PM PEAK PERIOD (3:00 – 5:00 PM)						
SOV	21%	60%	81%	77%	75%	72%
HOV 2	64	36	13	15	19	22
HOV 3+	10	1	1	<1	2	<1
Motorcycles	2	1	<1	<1	<1	<1
Heavy Vehicles	2	<1	5	7	4	5
Buses	1	1	<1	<1	<1	1
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Clean Air Vehicles	n/a	4%	n/a	n/a	n/a	n/a
HOV Eligible[1]	77%[2]	43%				

[1]Sum of HOV 2, HOV3+, Motorcycles, Buses, Clean Air Vehicles
[2]Not including Clean Air Vehicles
Data Source: Manual vehicle occupancy counts by Quality Counts LLC

6.5. MEASURE 5: VEHICLE THROUGHPUT

Vehicle throughput was reported in Table 22 and Table 23 (for the two-hour peak periods consistent with the vehicle occupancy data) and is summarized in Figure 18 to Figure 21 (for four-hour peak periods). Changes in vehicle throughput volumes between the Before and After conditions varied by location and time period.

In the AM peak period, total vehicle throughput increased at three of four northbound count locations and at one of the three southbound count locations. Volumes in the HOV/Express lanes increased at all locations (from 0.3 to 11 percent) except southbound at Greenbrook Drive, where there was a 2 percent decrease.

In the PM peak period, overall (all lanes) vehicle throughput increased at one of four northbound count locations and at one of three southbound count locations. The most significant increases were northbound at Greenbrook Drive, approaching the most congested part of the corridor, while the largest decreases were northbound at Alcosta Boulevard in the relatively uncongested south end of the corridor. The HOV/Express lane throughput increased northbound at Greenbrook Drive but also at all three southbound count locations.

The total vehicle throughput for the four-hour peak periods at all seven locations combined results in a 1.7 percent increase in total volume for the AM peak period and a 0.9 percent reduction in total volume in the PM peak period.

The reasons for the reduction in the PM peak period vehicle throughput are unknown, but could be related to changes in economic activity in the study corridor such as changes in employment at one or more major employers in the Bishop Ranch area of San Ramon. For example, several hundred jobs were transferred from the Chevron headquarters in San Ramon between 2015 and 2018.[1] Jobs may also have been reduced at the AT&T offices in San Ramon.[2]

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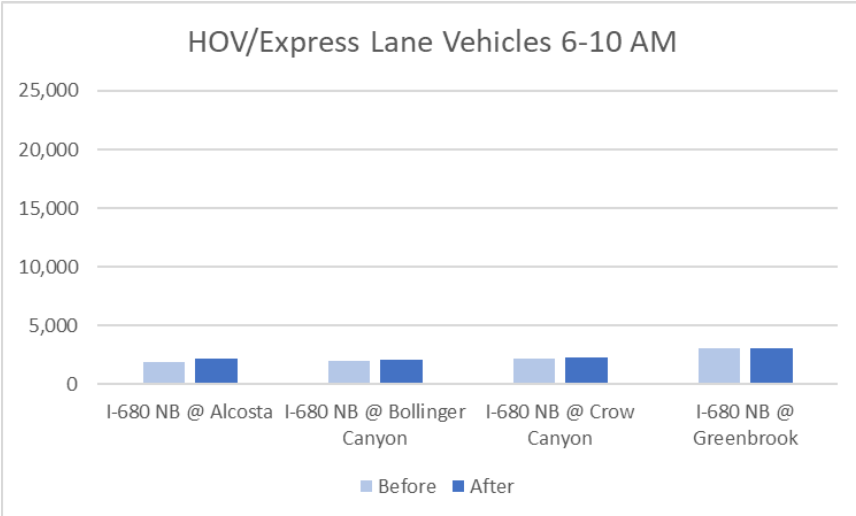
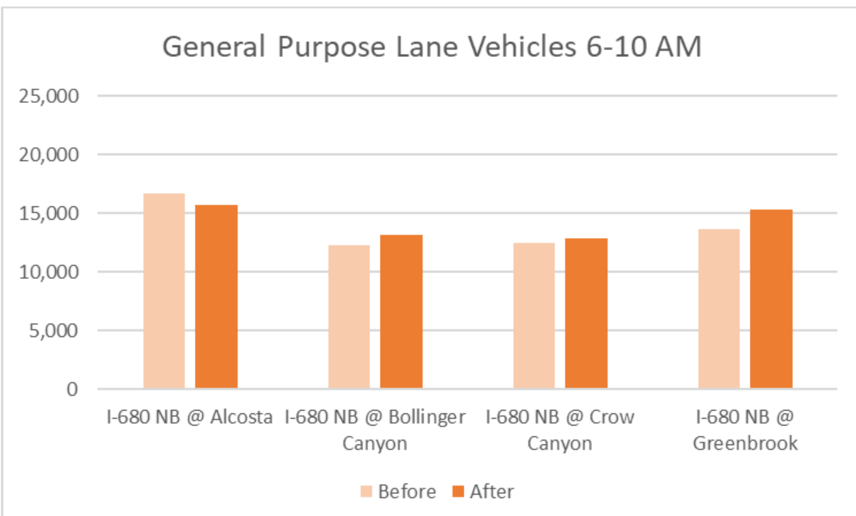
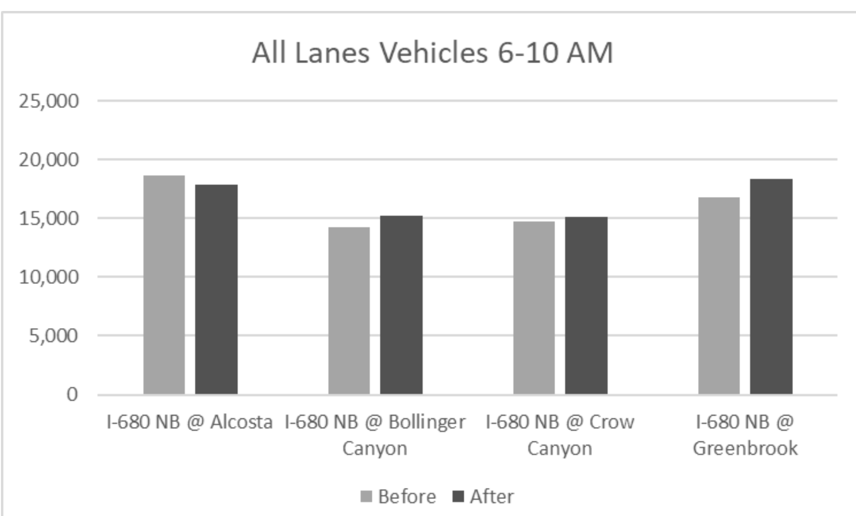
[1] San Francisco Business Times, "This Bay Area Fortune 500 has moved hundreds of employees to Texas. Will its headquarters follow?", March 6, 2019. https://www.bizjournals.com/sanfrancisco/news/2019/03/06/chevron-cvx-houston-headquarters-bay-area-exodus.html.

[2] Communications Workers of America, "California has been hardest hit by AT&T's call center closing and downsizing," May 4, 2017. https://district9.cwa-union.org/news/california-has-been-hardest-hit-atts-call-center-closing-and-downsizing

Figure 18: Vehicle Throughput, AM Peak Period, Northbound

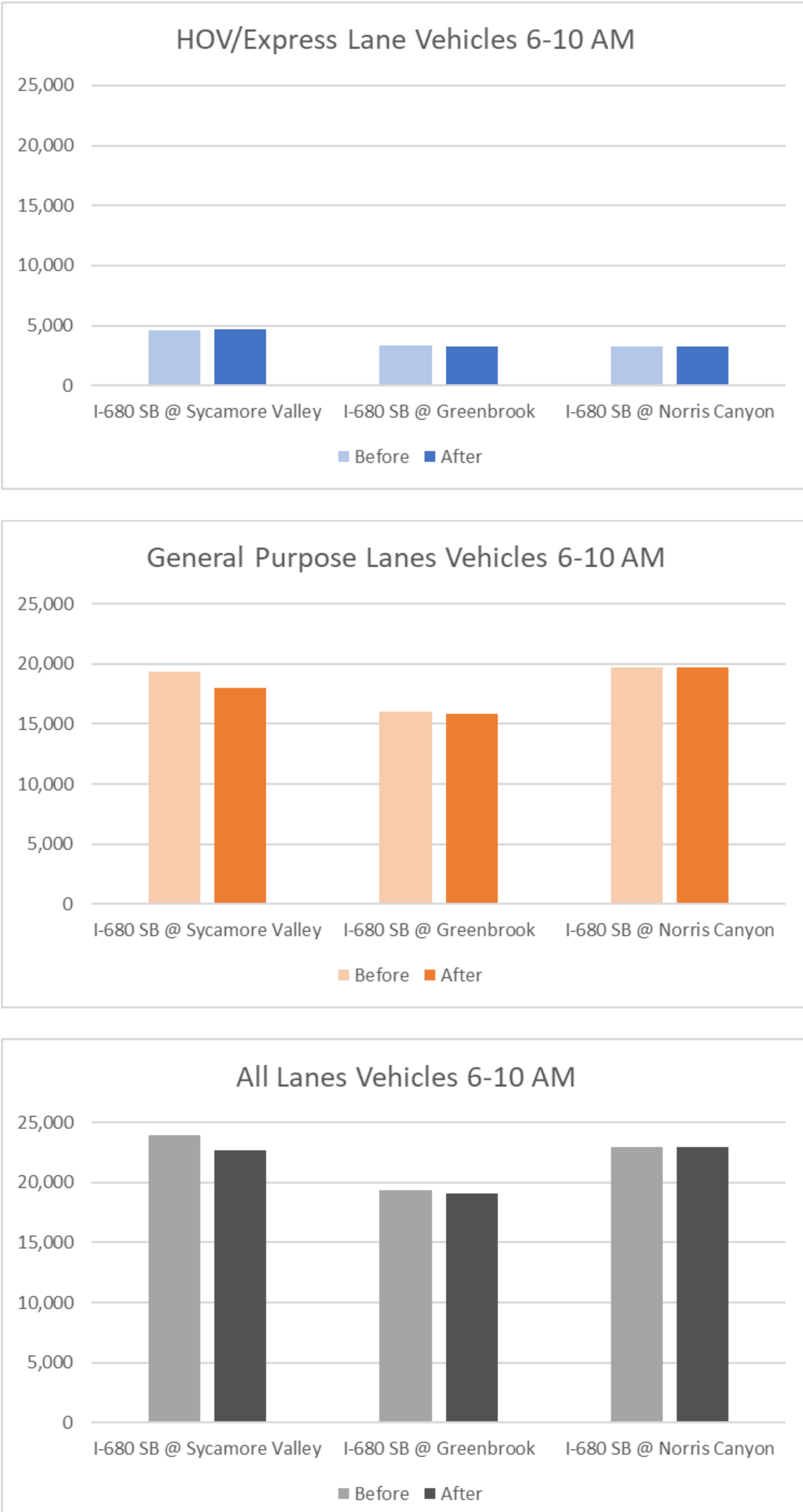






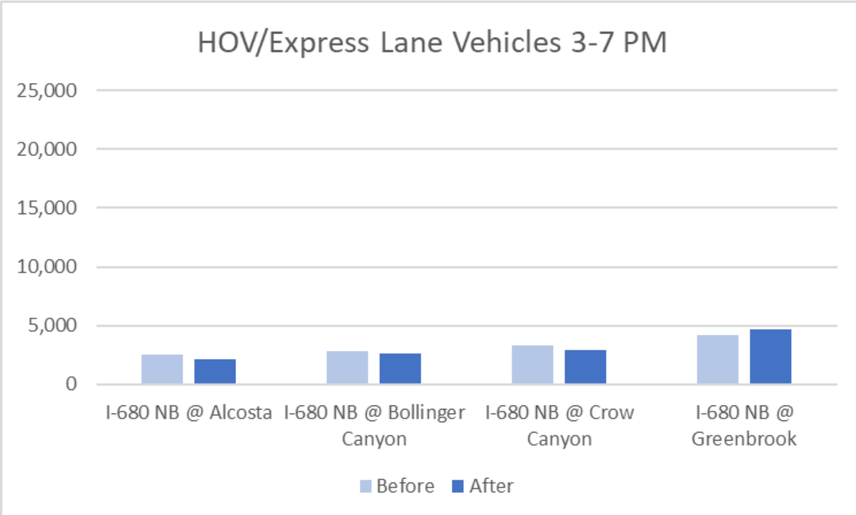
Data Source: Caltrans PeMS

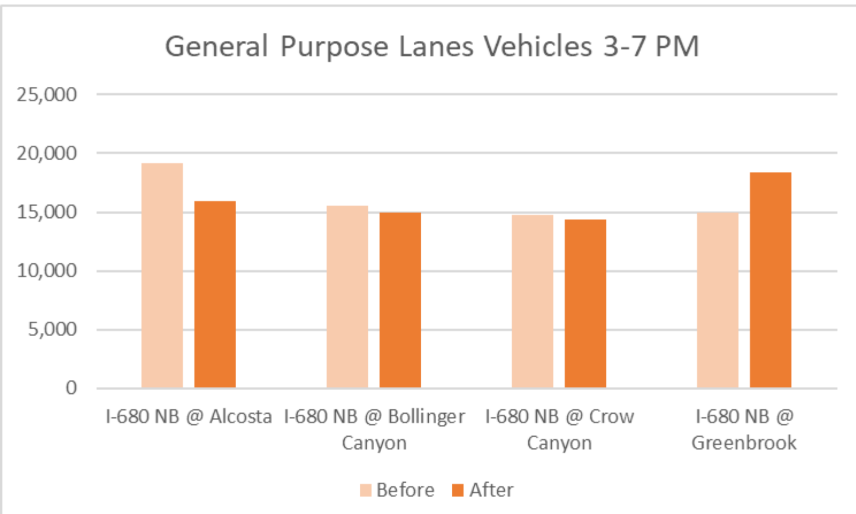
Figure 19: Vehicle Throughput, AM Peak Period, Southbound

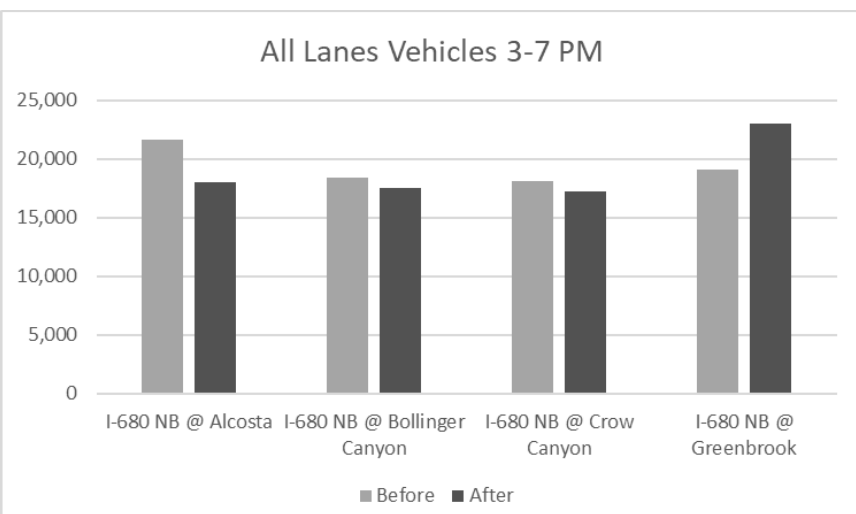


Data Source: Caltrans PeMS

Figure 20: Vehicle Throughput, PM Peak Period, Northbound

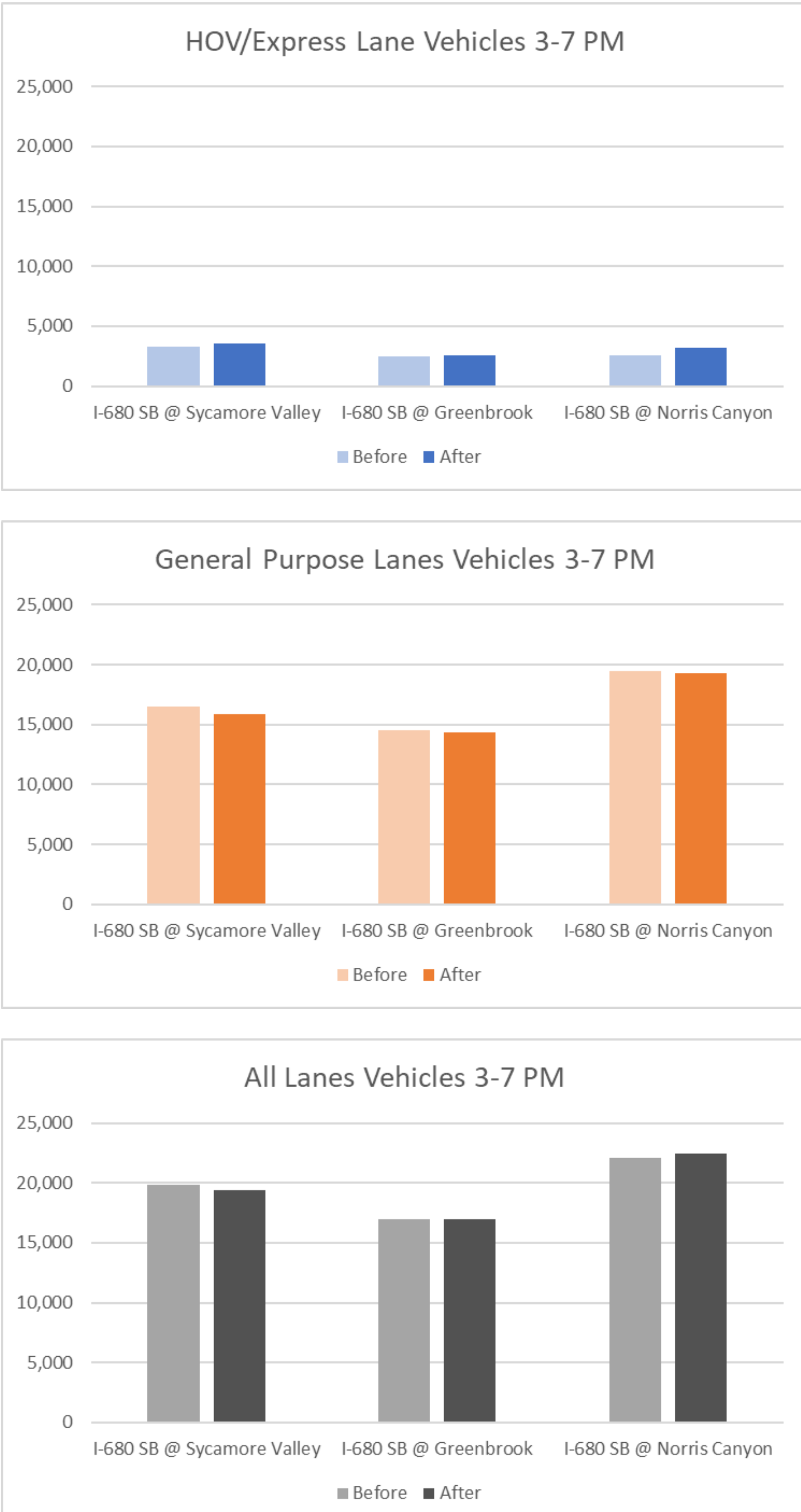






Data Source: Caltrans PeMS

Figure 21: Vehicle Throughput, PM Peak Period, Southbound



Data Source: Caltrans PeMS

As described in Section 7, vehicle throughput on the control corridor increased during the same time period, so the reductions in vehicle throughput on the southern part of the study corridor appear to be related to localized issues rather than general traffic trends. Since the throughput increased on the most congested portion of the study corridor, there is no evidence that implementation of the express lanes caused decreases in vehicle throughput.

6.6. MEASURE 6: PERSON THROUGHPUT

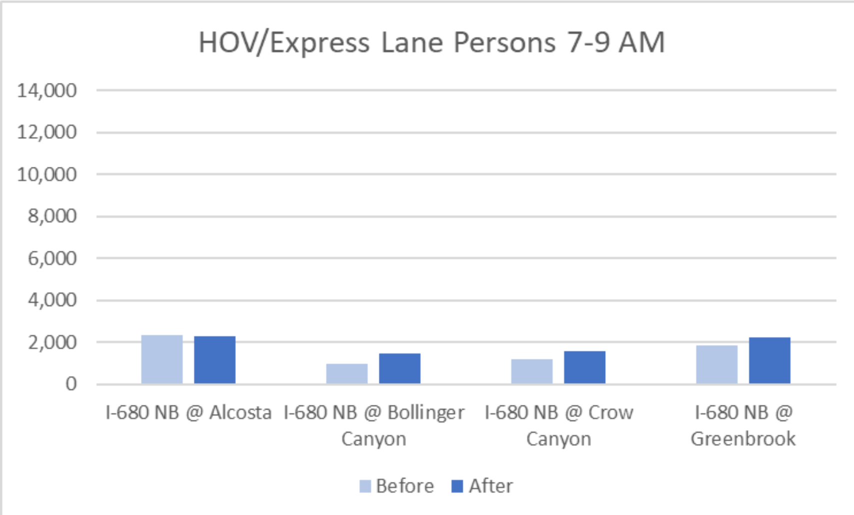
Person throughput was reported in Table 22 and Table 23 (for the two-hour peak periods consistent with the vehicle occupancy data) and is summarized in Figure 22 to Figure 25 (for two-hour peak periods).

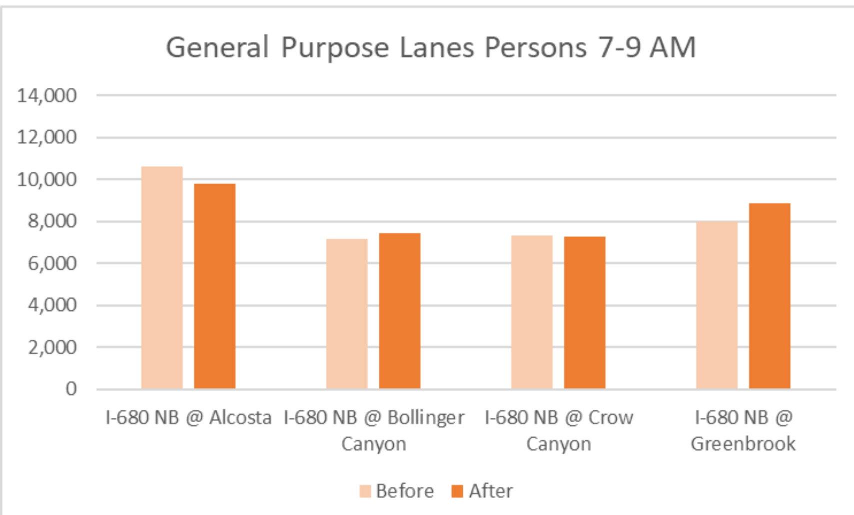
Changes in person throughput volumes between the Before and After conditions were generally consistent with the changes in vehicle throughput, with overall increases at the majority of locations in the AM peak period and decreases in the majority of locations in the PM peak period.

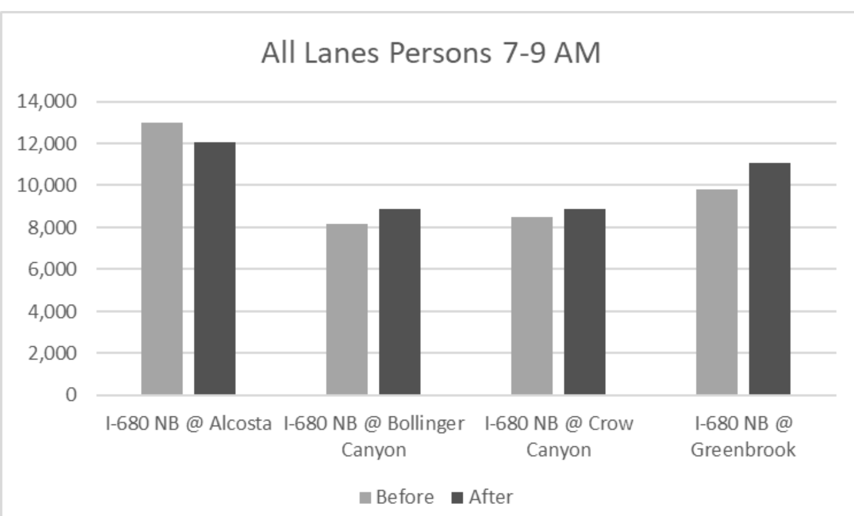
The largest increase in person throughput occurred at Greenbrook Drive northbound in the PM peak period (+1,760 or +13%). The largest decrease in person throughput occurred northbound at Alcosta Boulevard in the PM peak period (-3,640 or -26% in the two-hour period). Therefore, the highest increases in person throughput after the implementation of express lanes occurred in the most congested corridor conditions. As with the vehicle throughput, the decreases in person throughput in the south part of the corridor appear to be more related to activity changes in the San Ramon area rather than the operating conditions on the I-680 freeway.

The total person throughput for the two-hour peak periods at all seven locations combined results in a 1.4 percent increase in total person throughput for the AM peak period and a 3.8 percent reduction in total person throughput in the PM peak period.

Figure 22: Person Throughput, AM Peak Period, Northbound

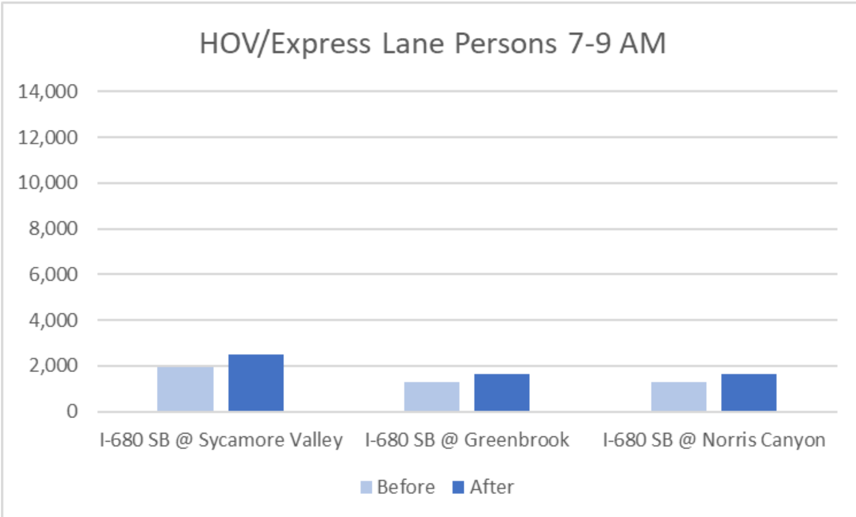


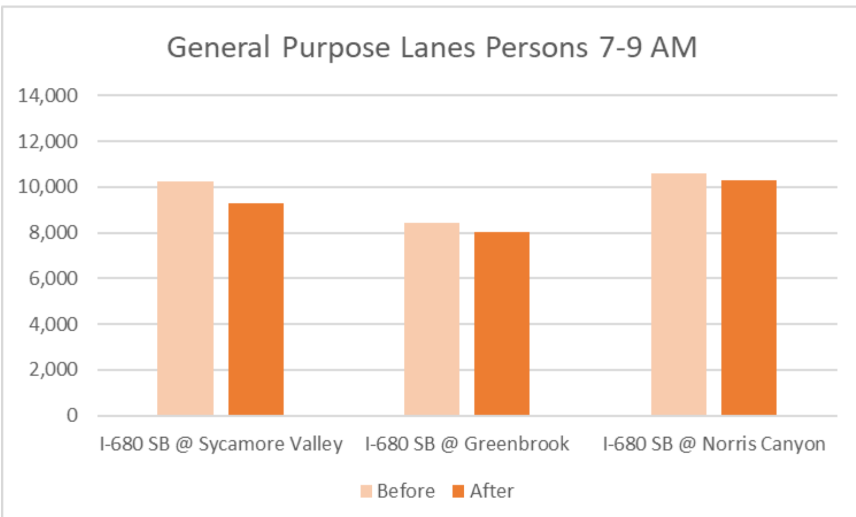


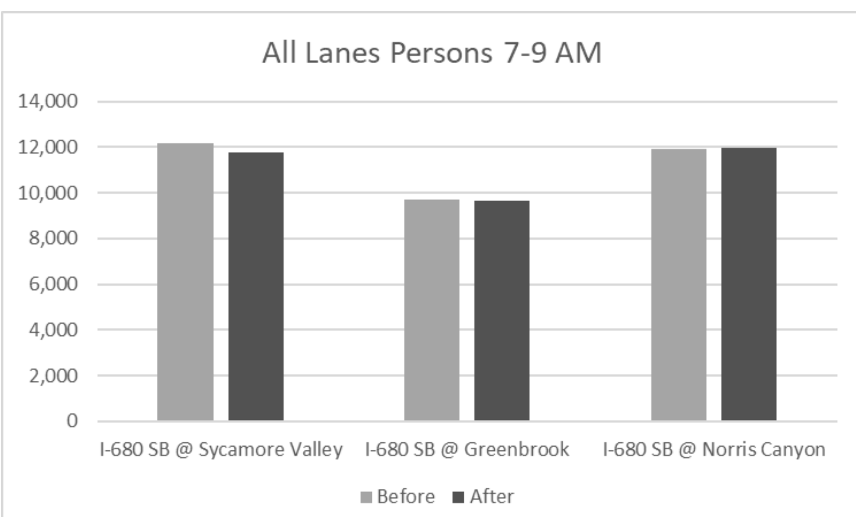


Data Sources: Manual vehicle occupancy counts by Quality Counts LLC, Caltrans PeMS

Figure 23: Person Throughput, AM Peak Period, Southbound

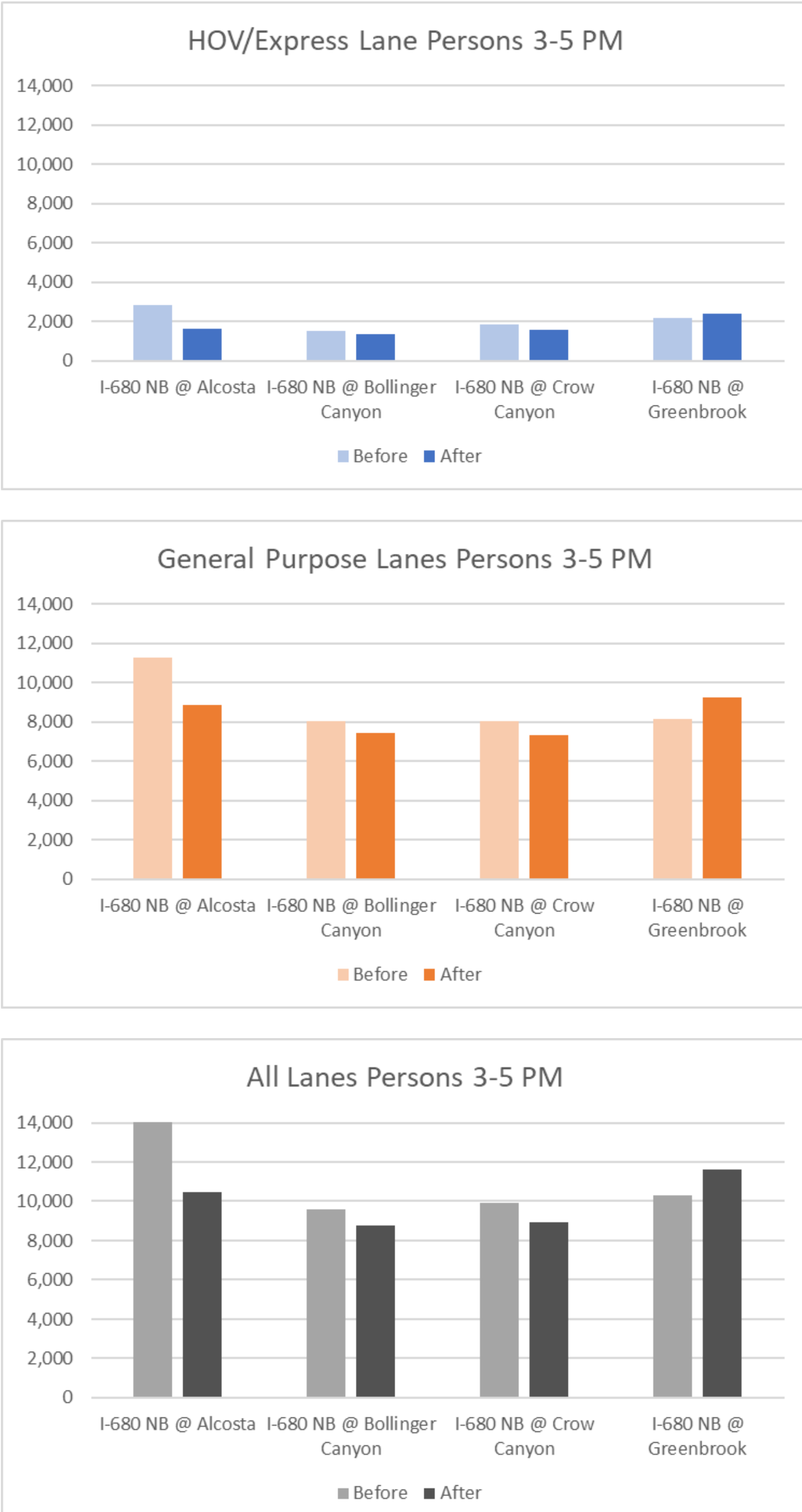






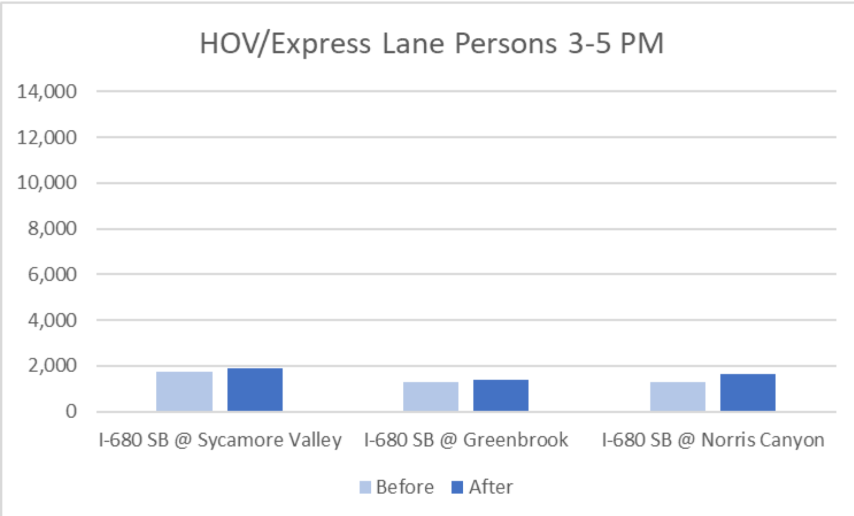
Data Sources: Manual vehicle occupancy counts by Quality Counts LLC, Caltrans PeMS

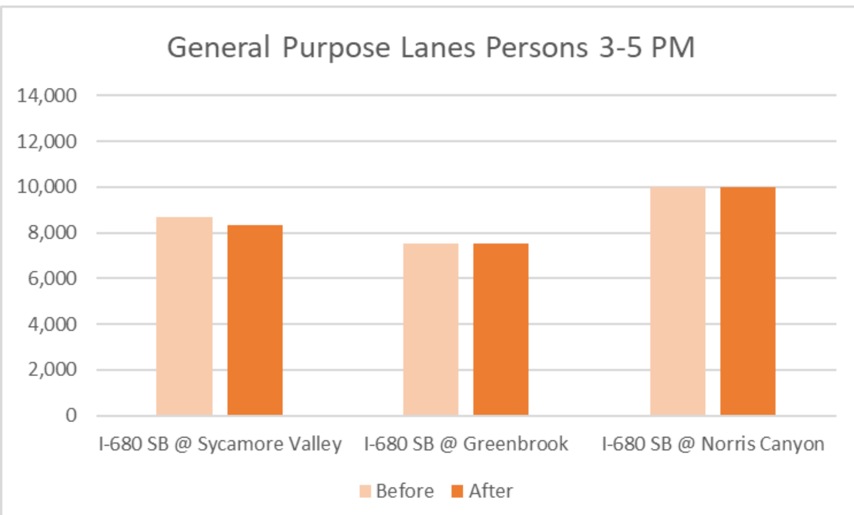
Figure 24: Person Throughput, PM Peak Period, Northbound

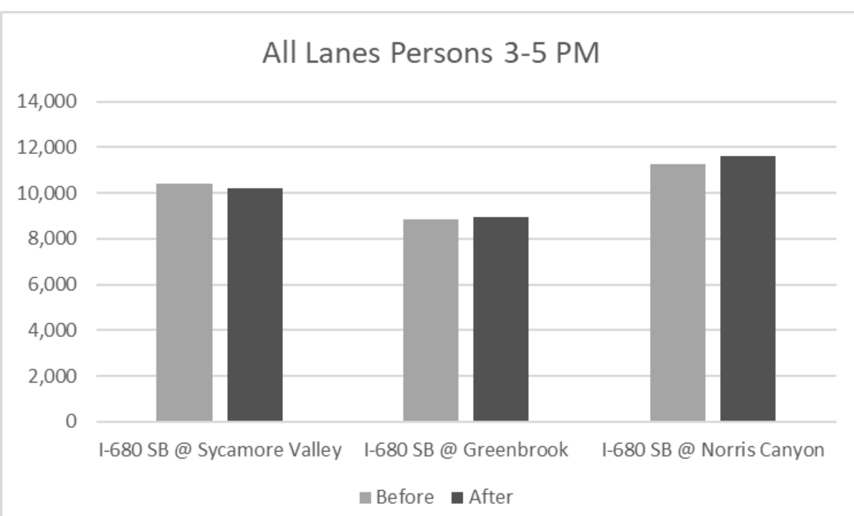


Data Sources: Manual vehicle occupancy counts by Quality Counts LLC, Caltrans PeMS

Figure 25: Person Throughput, PM Peak Period, Southbound







Data Sources: Manual vehicle occupancy counts by Quality Counts LLC, Caltrans PeMS

6.7. MEASURE 7: VEHICLE-HOURS OF DELAY

Vehicle-hours of delay (VHD) were tabulated by multiplying the delay on each segment (average observed time minus time at free-flow 65 miles per hour) by the representative volume on each segment. The total VHD for the AM and PM peak periods, within the segments including an HOV/Express lane, are listed in Table 31 and displayed in Figure 26 and Figure 27.

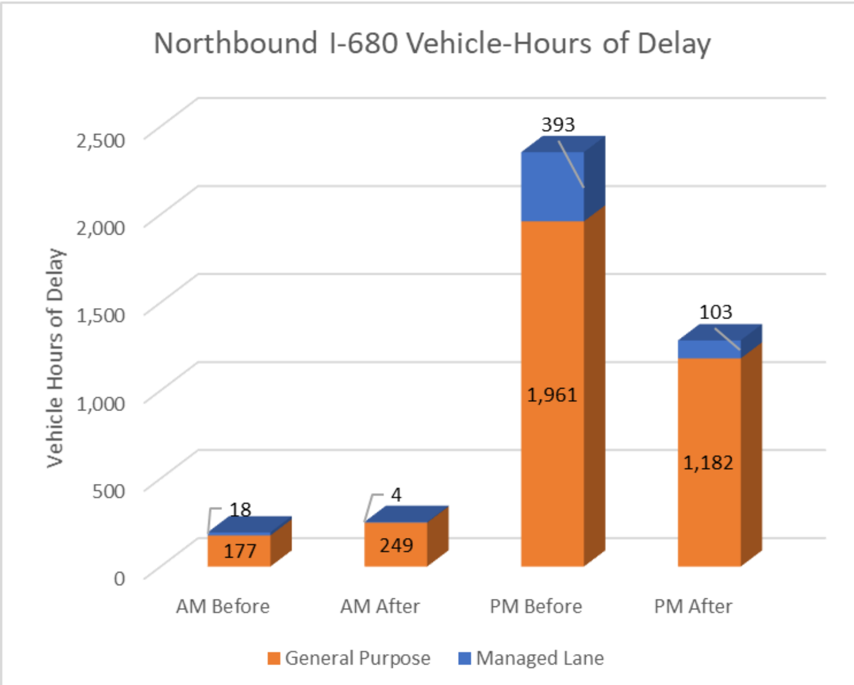
Table 31: Vehicle-Hours of Delay

	HOV Lane	Express Lane	GP Lanes	GP Lanes	All Lanes	All Lanes
	Before (2014)	After (2018)	Before (2014)	After (2018)	Before (2014)	After (2018)
AM PEAK PERIOD 5:00 TO 9:00 AM						
Northbound	18	4	177	249	195	253
Southbound	44	55	431	431	475	486
Total	**62**	**59**	**608**	**680**	**670**	**739**
PM PEAK PERIOD 3:00-7:00 PM						
Northbound	393	103	1,961	1,182	2,354	1,285
Southbound	29	22	249	438	278	460
Total	**422**	**125**	**2,210**	**1,620**	**2,632**	**1,745**
AM+PM PEAK PERIODS						
Northbound	411	107	2,138	1,431	2,549	1,538
Southbound	73	77	680	869	753	946
Total	**484**	**184**	**2,818**	**2,300**	**3,302**	**2,484**
Percent Change		-62%		-18%		-25%

Northbound from Alcosta Blvd. On-Ramp to Livorna Rd. On-Ramp
Southbound from Rudgear Rd. On-Ramp to Alcosta Blvd. Off-Ramp
Sources: Volumes from PeMS, travel times from floating car surveys and INRIX.

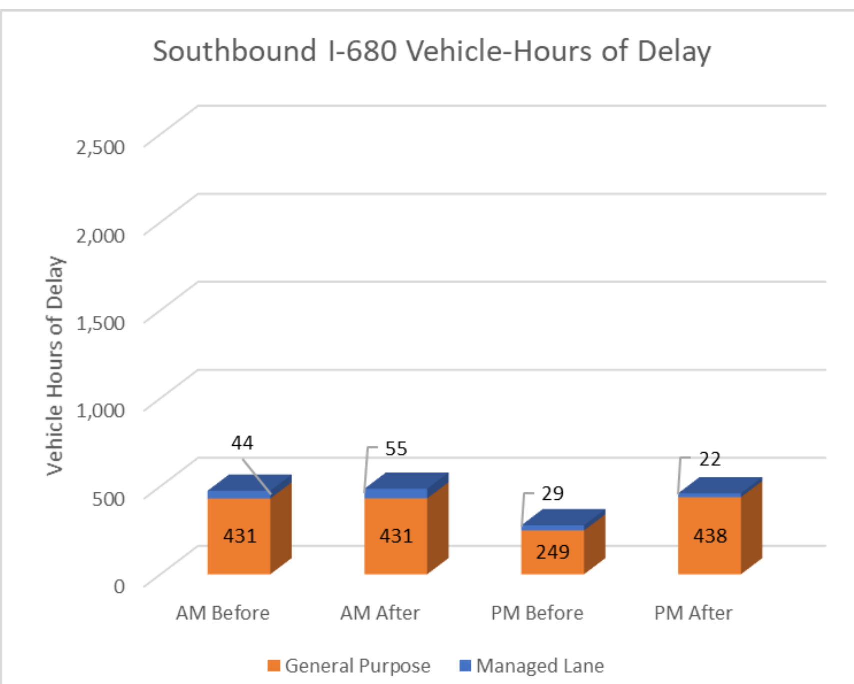
Conditions after the implementation of the express lanes resulted in significant decreases in total peak period vehicle-hours of delay. There was a reduction of 62 percent in peak period VHD in the HOV/Express lanes, an 18 percent reduction in the general purpose lanes, and a 25 percent overall reduction in peak period delay. The most significant decreases in VHD occurred in the northbound direction during the PM peak period. There were actually increases in VHD reported for the southbound direction during the AM and PM peak periods. However, the decreases in northbound delay were large enough such that there were overall reductions in corridor VHD during both peak periods.

Figure 26: Vehicle-Hours of Delay during Peak Periods, Northbound



Northbound from Alcosta Blvd. On-Ramp to Livorna Rd. On-Ramp
Peak periods are 5:00 to 9:00 AM and 3:00 to 7:00 PM.
Source: Kittelson & Associates, Inc., based on volumes from PeMS and travel times from floating car surveys and INRIX

Figure 27: Vehicle-Hours of Delay during Peak Periods, Southbound



Southbound from Rudgear Rd. On-Ramp to Alcosta Blvd. Off-Ramp
Peak periods are 5:00 to 9:00 AM and 3:00 to 7:00 PM.
Source: Kittelson & Associates, Inc., based on volumes from PeMS and travel times from floating car surveys and INRIX

6.8. MEASURE 8: LEVEL OF SERVICE

Level of service (LOS) was calculated at each traffic count location for each hour of the AM and PM peak periods. The LOS was evaluated separately for the HOV/Express lanes (Table 32) and general purpose lanes (Table 33).

HOV/Express Lane Level of Service

During the Before study, the LOS in the HOV lanes was LOS C or better during the AM peak period, with one exception, LOS D southbound at Stone Valley Road for one hour. The LOS in the express lanes in the After study changed to LOS D from one to three hours southbound at Stone Valley Road during the AM peak period. At other locations in the After study, the AM LOS at nearly all locations and time periods stayed the same or improved compared to the Before study.

For the Before study PM peak period LOS in the HOV lanes in the northbound direction, LOS E (three hours) and F (one hour) conditions were reported at Stone Valley Road, and LOS D conditions were reported for one hour at Greenbrook Drive. In the After study, the express Lane LOS at Stone Valley Road improved to one hour of LOS E and 1 hour of LOS D, and from LOS D to C at Greenbrook Drive. In the southbound direction, the LOS was C or better at all locations during the PM peak period in both the Before and After studies.

General Purpose Lane Level of Service

During the Before study, in the AM peak period, the northbound general purpose lanes operated at LOS D or better at all locations except for LOS E operations south of Livorna Road during the hour from 8:00 to 9:00 AM. In the southbound direction, LOS E or F operations occurred during three hours south of Livorna Road, with LOS D or better operations at all locations to the south. During the After study, the northbound express lane LOS south of Livorna Road improved to LOS D, while the LOS at Alcosta Boulevard changed from D to E during one hour. In the southbound direction, the segment south of Livorna Road improved from two hours of LOS F and one hour of LOS E to LOS E during one hour and LOS D during two hours.

The Before study PM peak period LOS in the northbound direction reported LOS E or F during two hours at Greenbrook Drive and three hours south of Livorna Road. In the southbound direction, LOS E operations occurred for one hour south of Livorna Road and for one hour at Norris Canyon Road. In the After study, the northbound LOS at Greenbrook Drive improved from LOS F to LOS D or better, and the LOS south of Livorna Road improved from three hours of LOS F and one hour of LOS E to one hour of LOS F and one hour of LOS E. In the southbound direction, the one hour of LOS E operations remained at Norris Canyon Road but improved to LOS D south of Livorna Road.

In general, LOS conditions after the implementation of express lanes improved in the most congested corridor segments. There were some decreases in LOS in the less congested southbound direction.

Table 32: Level of Service and Vehicle Density, HOV/Express Lanes

	AM Peak Period					PM Peak Period			
	5:00 to 6:00	6:00 to 7:00	7:00 to 8:00	8:00 to 9:00	9:00 to 10:00	3:00 to 4:00	4:00 to 5:00	5:00 to 6:00	6:00 to 7:00
NORTHBOUND									
Alcosta Boulevard									
Before	A (0.7)	A (2.1)	A (7.5)	A (10.3)	A (10.8)	A (8.9)	A (9.0)	A (9.4)	A (8.0)
After	A (0.7)	A (2.3)	B (11.5)	B (13.5)	A (6.1)	A (6.9)	A (7.4)	A (8.9)	A (6.6)
Bollinger Canyon Road									
Before	A (0.9)	A (2.4)	A (6.6)	A (7.4)	B (11.9)	A (10.7)	A (10.6)	A (10.0)	A (8.2)
After	A (0.7)	A (2.8)	A (9.5)	A (10.1)	A (6.1)	A (9.1)	A (9.3)	A (9.6)	A (8.0)
Crow Canyon Road									
Before	A (0.9)	A (2.6)	A (7.9)	A (8.4)	B (12.2)	B (12.8)	B (13.4)	B (13.4)	A (8.6)
After	A (0.7)	A (3.1)	A (10.5)	A (11.0)	A (6.2)	A (10.7)	B (11.4)	A (11.0)	A (8.4)
Greenbrook Drive									
Before	A (1.2)	A (3.1)	A (10.9)	B (15.6)	B (14.8)	C (18.3)	C (24.4)	D (28.2)	B (16.3)
After	A (1.0)	A (3.5)	B (12.0)	C (18.4)	A (8.6)	B (16.3)	B (17.9)	B (17.9)	B (14.3)
Stone Valley Road									
Before	A (1.4)	A (4.4)	B (14.4)	C (18.9)	C (22.0)	E (37.7)	E (40.3)	F (50.5)	E (37.5)
After	A (1.1)	A (4.8)	C (19.1)	C (24.2)	B (15.0)	C (25.5)	D (33.8)	E (36.7)	B (16.2)
SOUTHBOUND									
Stone Valley Road									
Before	A (8.1)	B (17.5)	C (25.5)	C (24.5)	D (33.8)	B (12.5)	B (16.4)	C (20.5)	B (11.9)
After	A (9.3)	C (18.3)	D (29.5)	D (29.1)	D (31.5)	B (11.8)	B (17.9)	C (23.3)	A (9.4)
Sycamore Valley Road									
Before	A (8.4)	B (14.5)	B (14.6)	B (13.2)	C (25.1)	B (11.5)	B (12.7)	B (13.5)	A (9.9)
After	A (10.6)	B (17.1)	C (18.3)	B (17.6)	B (16.5)	B (12.4)	B (14.3)	B (15.8)	A (8.8)
Greenbrook Drive									
Before	A (7.4)	A (10.3)	A (9.7)	A (8.4)	C (18.8)	A (8.6)	A (9.1)	A (9.7)	A (6.8)
After	A (9.0)	B (12.5)	B (11.6)	B (11.4)	A (10.8)	A (8.7)	A (10.6)	B (12.5)	A (6.1)
Norris Canyon Road									
Before	A (6.8)	A (9.9)	A (9.3)	A (8.4)	B (17.7)	A (8.6)	A (8.9)	B (13.8)	A (6.9)
After	A (8.7)	B (11.7)	B (11.5)	B (11.1)	A (10.6)	A (9.5)	B (13.4)	C (20.2)	A (6.6)

Sources: Volumes from PeMS, travel times from floating car surveys and INRIX.

Table 33: Level of Service and Vehicle Density, General Purpose Lanes

	AM Peak Period					PM Peak Period			
	5:00 to 6:00	6:00 to 7:00	7:00 to 8:00	8:00 to 9:00	9:00 to 10:00	3:00 to 4:00	4:00 to 5:00	5:00 to 6:00	6:00 to 7:00
NORTHBOUND									
Alcosta Boulevard									
Before	A (7.5)	B (16.0)	D (28.2)	D (32.0)	C (21.2)	C (25.2)	C (25.0)	D (26.3)	C (24.3)
After	A (8.7)	B (15.7)	C (25.8)	D (34.6)	C (23.3)	C (19.1)	C (19.8)	C (24.2)	C (21.4)
Bollinger Canyon Road									
Before	A (5.6)	B (11.6)	C (19.2)	C (18.9)	B (14.9)	C (20.9)	C (20.5)	C (20.9)	C (18.7)
After	A (6.5)	B (12.7)	C (20.0)	C (19.0)	B (17.4)	C (18.5)	C (18.7)	C (20.8)	C (18.8)
Crow Canyon Road									
Before	A (5.7)	B (12.1)	C (19.7)	C (18.8)	B (14.2)	C (21.9)	C (21.2)	C (20.5)	B (17.8)
After	A (6.4)	B (12.5)	C (19.5)	B (17.9)	B (16.1)	C (18.9)	C (18.8)	C (18.9)	B (17.2)
Greenbrook Drive									
Before	A (6.1)	B (13.3)	C (21.8)	C (21.6)	B (15.9)	D (28.4)	F (45.2)	F (60.7)	E (41.8)
After	A (7.1)	B (13.5)	C (22.8)	C (24.6)	C (20.2)	E (36.2)	D (33.8)	D (27.8)	C (22.9)
Stone Valley Road									
Before	A (7.3)	B (16.8)	D (27.4)	D (30.5)	C (19.9)	E (35.1)	F (52.2)	F (60.3)	F (57.0)
After	A (8.1)	B (16.6)	D (26.9)	D (28.0)	C (25.8)	C (25.6)	E (41.0)	F (50.2)	E (39.6)
SOUTHBOUND									
Stone Valley Road									
Before	C (18.2)	D (27.8)	E (40.1)	E (43.9)	D (31.2)	D (27.9)	D (29.4)	D (33.1)	D (27.1)
After	C (21.0)	D (28.2)	E (36.6)	E (41.4)	E (36.3)	D (28.1)	D (29.0)	D (33.1)	D (29.4)
Sycamore Valley Road									
Before	B (15.0)	D (26.2)	D (28.9)	D (27.0)	C (21.9)	C (22.1)	C (23.3)	C (23.5)	C (18.7)
After	C (18.1)	C (22.9)	C (24.8)	C (24.3)	C (23.0)	C (21.6)	C (21.4)	C (22.6)	C (18.7)
Greenbrook Drive									
Before	B (14.4)	C (20.7)	C (22.5)	C (20.8)	C (18.1)	C (18.6)	C (19.4)	C (20.5)	B (16.5)
After	B (16.4)	C (20.0)	C (20.9)	C (20.3)	C (19.6)	C (19.0)	C (19.2)	C (24.5)	B (17.2)
Norris Canyon Road									
Before	B (11.3)	C (18.1)	C (20.9)	C (20.2)	B (16.6)	C (18.5)	C (19.8)	C (26.0)	B (17.2)
After	B (13.6)	B (17.1)	C (19.4)	C (20.0)	C (18.3)	C (19.0)	C (21.9)	E (40.1)	C (18.6)

Sources: Volumes from PeMS, travel times from floating car surveys and INRIX.

6.9. MEASURE 9: TRAVEL TIME RELIABILITY

Reliability of a freeway system is measured by the amount of variation of travel times. Travel time variability is often as large or a larger concern than average travel time. Freight traffic, especially where just-in-time inventories are being served, is especially sensitive to travel time variability.

The travel time reliability measures were based on the PeMS data set for the HOV/Express lanes and the INIRX data set for all lanes. For each hour, the 50th percentile (median) and 95th percentile corridor travel times can be calculated.

The "Travel Time Index" (50th percentile time divided by free flow travel time) and "Planning Time Index" (95th percentile time divided by free-flow travel time) were calculated for each hour of the AM and PM peak periods. The Travel Time Index (TTI) is an indicator of the average time compared to free-flow time. The Planning Time Index (PTI) represents the extra time that travelers need to budget to reliably predict their travel time through the corridor.

All Lanes Reliability

The reliability statistics for all lanes based on INRIX data are shown in Table 34, Table 35 and Figure 28 to Figure 31.

The least reliable travel times occurred in the northbound direction during the PM peak period. Median travel times as indicated by the TTI were more than double the free-flow times during the Before and Supplemental Before studies; the highest TTI in the After study was about 1.9 times free-flow time. The PTI approached 4.0 during the Before study, meaning that travelers would need to budget nearly 40 minutes for a trip that would take 10 minutes without congestion in order to have a 95 percent probability of arriving on time. In the After conditions, the maximum PTI was reduced to about 2.6.

The northbound AM peak period conditions were very similar for all three study scenarios, with median times up to 1.3 times free-flow times and PTI up to 1.8, indicating that peak period travelers should budget almost double the free-flow time.

The southbound conditions during the AM peak period had similar PTIs as the northbound direction, approaching 2.0. However, the median times were higher, indicated by maximum TTIs around 1.5. The southbound PM peak period traffic had the least variability, with maximum TTIs around 1.4 and maximum PTIs around 1.7. This indicates that there were relatively few times when congestion worsened significantly compared to average conditions.

In summary, the reliability improved for the most congested conditions, northbound during the PM peak period, after the implementation of express lanes. During the AM peak period or southbound during the PM peak period, the express lane implementation did not have a consistent effect on reliability measures.

Table 34: All Lanes Reliability Measures, Northbound

Time	Study	Travel Time 50th Percentile	Travel Time 95th Percentile	Travel Time Index	Planning Time Index
5:00 AM	Before	11.52	11.95	1.05	1.09
	Supplemental	11.64	12.08	1.07	1.11
	After	11.29	11.67	1.03	1.07
6:00 AM	Before	11.39	11.97	1.04	1.10
	Supplemental	11.32	11.90	1.04	1.09
	After	10.95	11.49	1.00	1.05
7:00 AM	Before	12.24	13.83	1.12	1.27
	Supplemental	12.22	13.32	1.12	1.22
	After	11.87	13.56	1.09	1.24
8:00 AM	Before	13.55	20.08	1.24	1.84
	Supplemental	14.16	18.67	1.30	1.71
	After	13.33	19.10	1.22	1.75
9:00 AM	Before	11.94	17.48	1.09	1.60
	Supplemental	11.90	16.46	1.09	1.51
	After	11.80	18.36	1.08	1.68
3:00 PM	Before	14.09	25.30	1.29	2.32
	Supplemental	17.70	24.92	1.62	2.28
	After	16.03	24.87	1.47	2.28
4:00 PM	Before	21.06	37.05	1.93	3.39
	Supplemental	22.48	32.93	2.06	3.01
	After	20.41	28.15	1.87	2.58
5:00 PM	Before	24.67	42.10	2.26	3.85
	Supplemental	22.32	36.27	2.04	3.32
	After	19.87	28.08	1.82	2.57
6:00 PM	Before	18.92	35.18	1.73	3.22
	Supplemental	15.24	27.33	1.40	2.50
	After	14.07	21.43	1.29	1.96

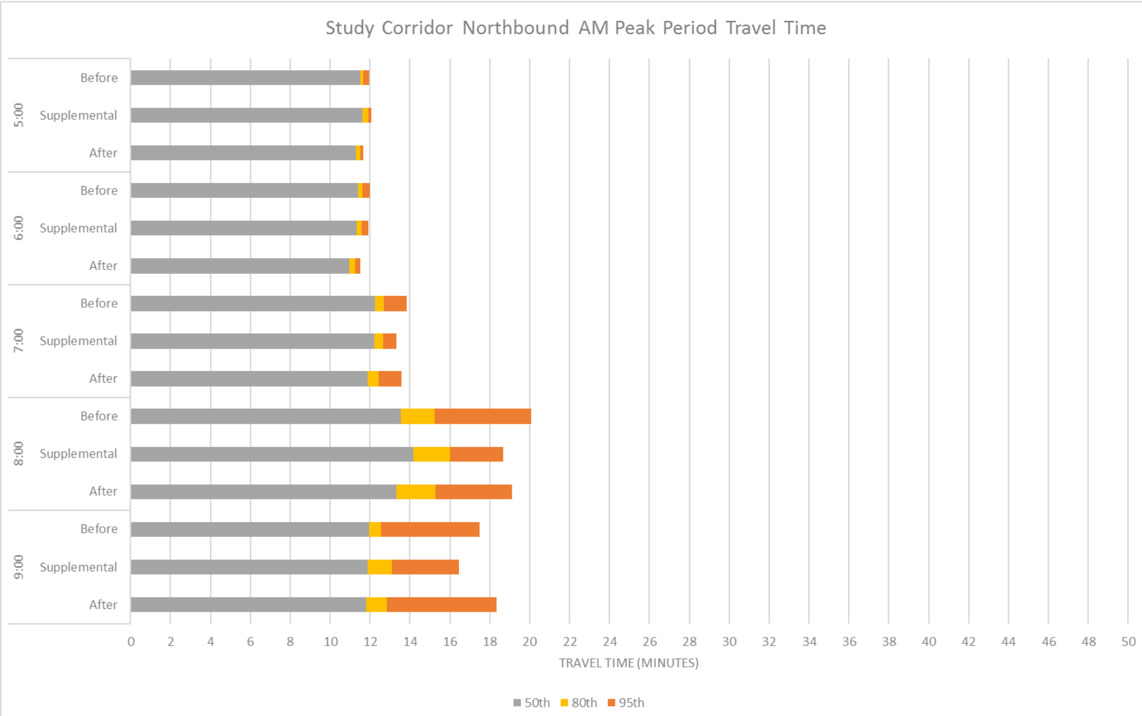
Source: Kittelson & Associates, Inc., based on 12 months of INRIX data for each study period.

Table 35: All Lanes Reliability Measures, Southbound

Time	Study	Travel Time 50th Percentile	Travel Time 95th Percentile	Travel Time Index	Planning Time Index
5:00 AM	Before	11.28	11.79	1.02	1.07
	Supplemental	11.23	11.96	1.02	1.08
	After	11.16	11.52	1.01	1.04
6:00 AM	Before	11.84	12.58	1.07	1.14
	Supplemental	11.94	12.86	1.08	1.16
	After	11.63	12.44	1.05	1.12
7:00 AM	Before	15.45	17.92	1.40	1.62
	Supplemental	15.34	18.10	1.39	1.64
	After	14.47	17.49	1.31	1.58
8:00 AM	Before	16.16	21.66	1.46	1.96
	Supplemental	16.94	19.92	1.53	1.80
	After	15.87	18.96	1.43	1.71
9:00 AM	Before	12.85	18.85	1.16	1.70
	Supplemental	13.94	18.21	1.26	1.65
	After	14.48	17.50	1.31	1.58
3:00 PM	Before	11.90	13.26	1.08	1.20
	Supplemental	11.78	12.76	1.06	1.15
	After	11.96	13.51	1.08	1.22
4:00 PM	Before	12.33	15.27	1.11	1.38
	Supplemental	12.85	16.49	1.16	1.49
	After	13.15	16.59	1.19	1.50
5:00 PM	Before	15.09	19.20	1.36	1.74
	Supplemental	15.79	19.12	1.43	1.73
	After	15.58	18.25	1.41	1.65
6:00 PM	Before	12.98	16.78	1.17	1.52
	Supplemental	12.55	15.72	1.13	1.42
	After	12.37	15.69	1.12	1.42

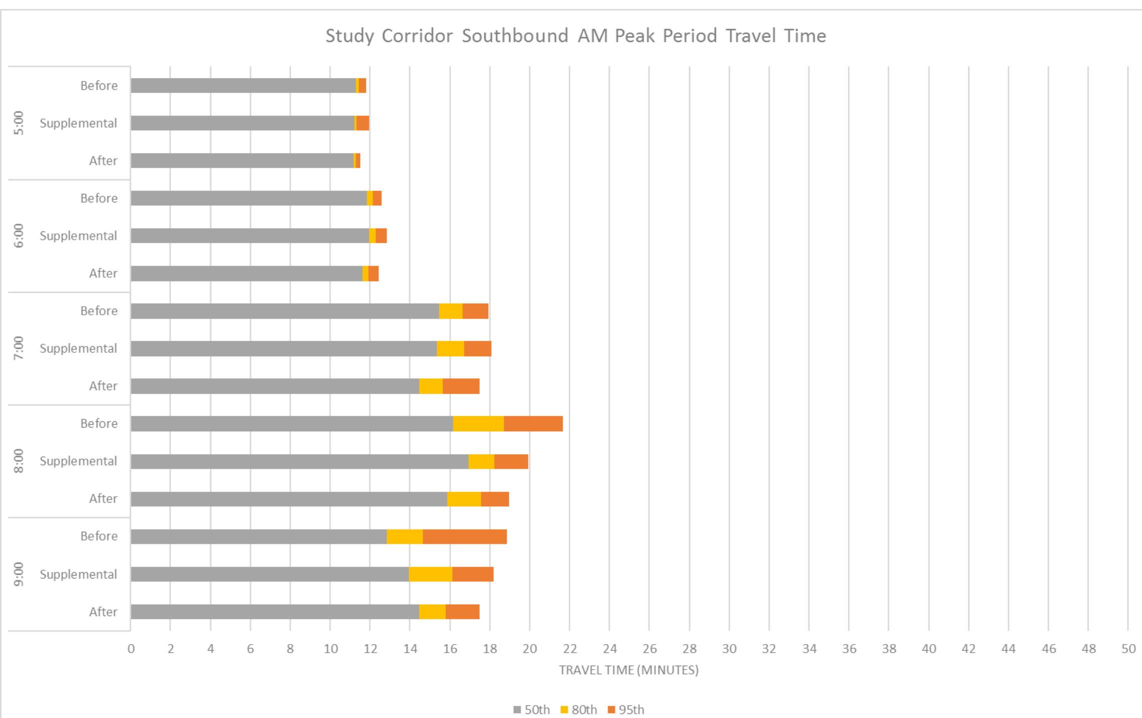
Source: Kittelson & Associates, Inc., based on 12 months of INRIX data for each study period.

Figure 28: Study Corridor Median, 80th and 95th Percentile Travel Times, AM Peak Period, Northbound, All Lanes



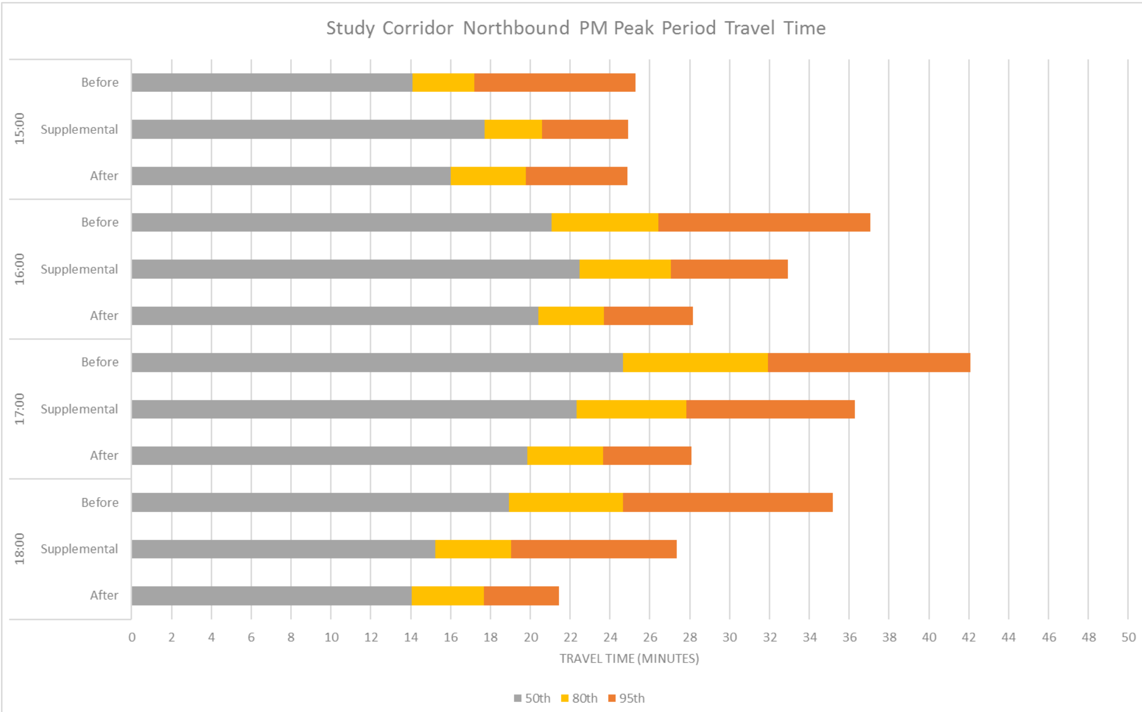
Source: Kittelson & Associates, Inc., based on 12 months of INRIX data for each study period.

Figure 29: Study Corridor Median, 80th and 95th Percentile Travel Times, AM Peak Period, Southbound, All Lanes



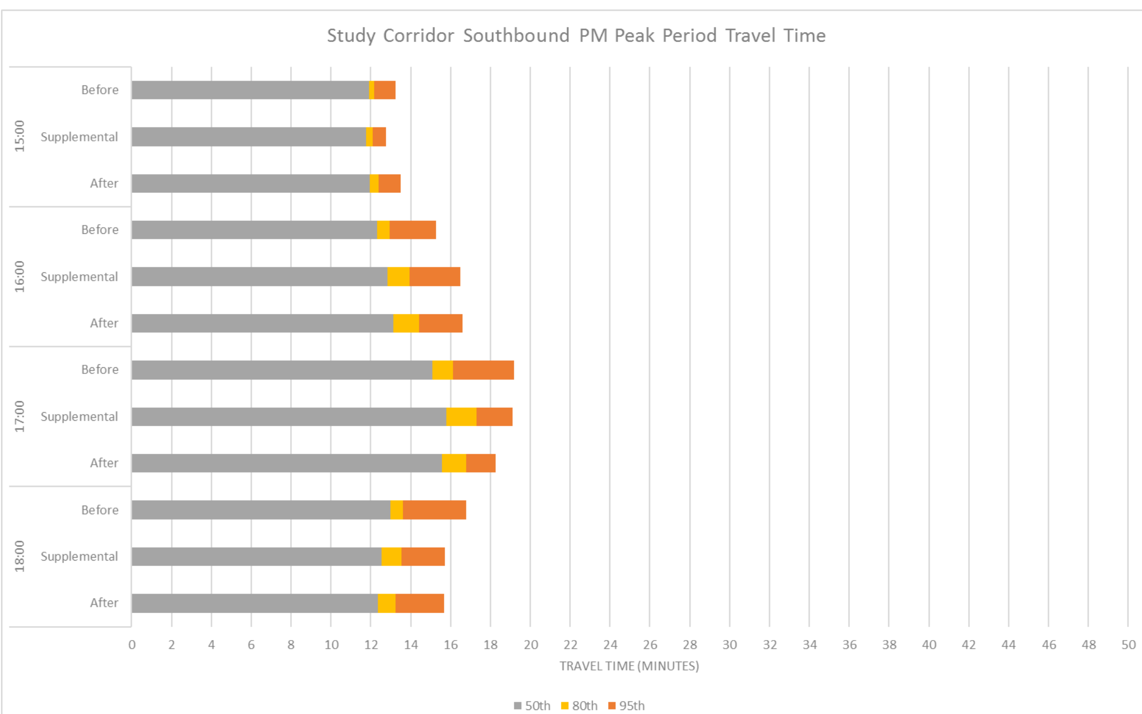
Source: Kittelson & Associates, Inc., based on 12 months of INRIX data for each study period.

Figure 30: Study Corridor Median, 80th and 95th Percentile Travel Times, PM Peak Period, Northbound, All Lanes



Source: Kittelson & Associates, Inc., based on 12 months of INRIX data for each study period.

Figure 31: Study Corridor Median, 80th and 95th Percentile Travel Times, PM Peak Period, Southbound, All Lanes

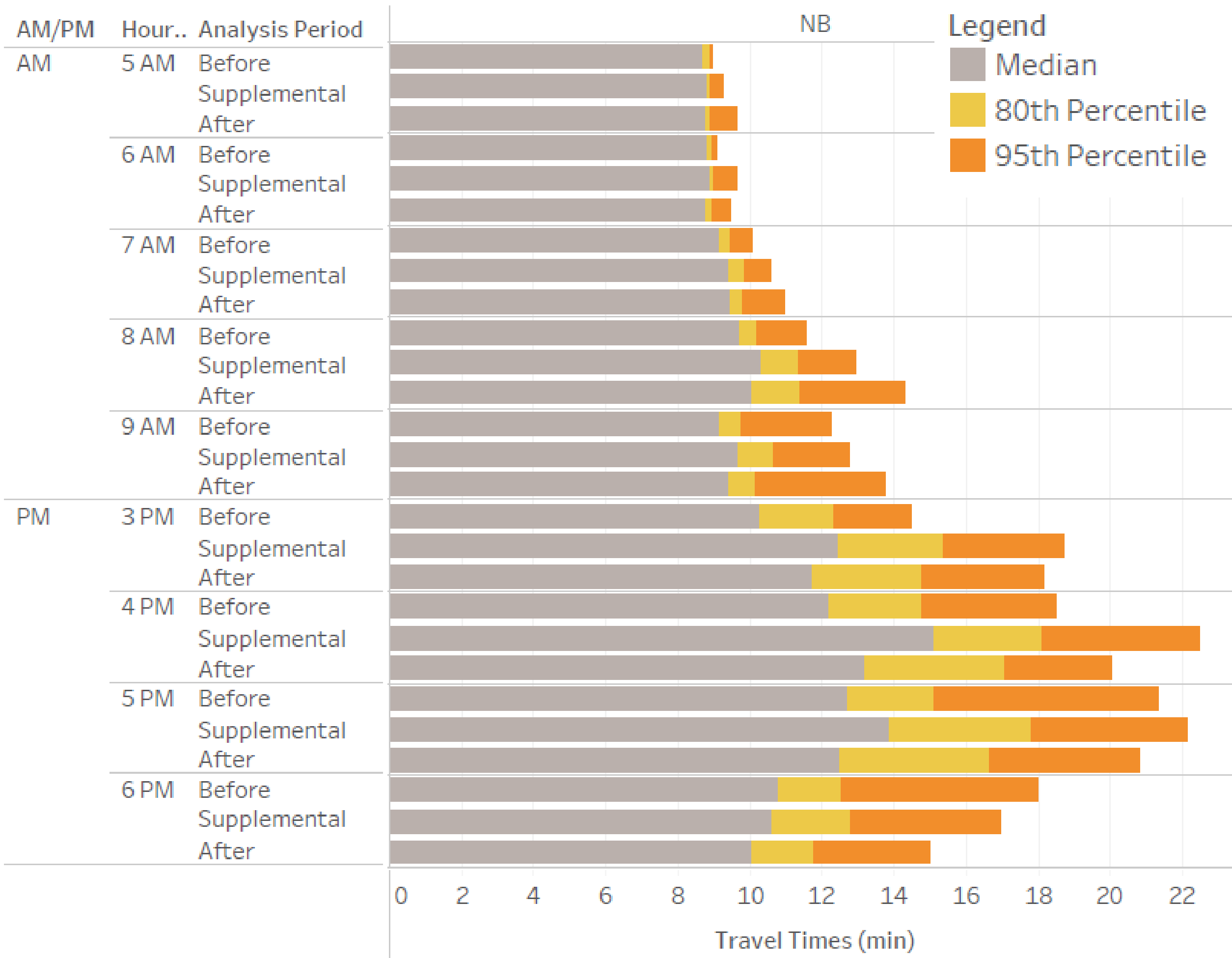


Source: Kittelson & Associates, Inc., based on 12 months of INRIX data for each study period.

HOV/Express Lane Reliability

Reliability measures for the HOV/Express lane were calculated based on 12 months of PeMS data, as INRIX data does not distinguish between individual lanes (Figure 32 and Figure 33).

Figure 32: HOV/Express Lane Reliability, Northbound



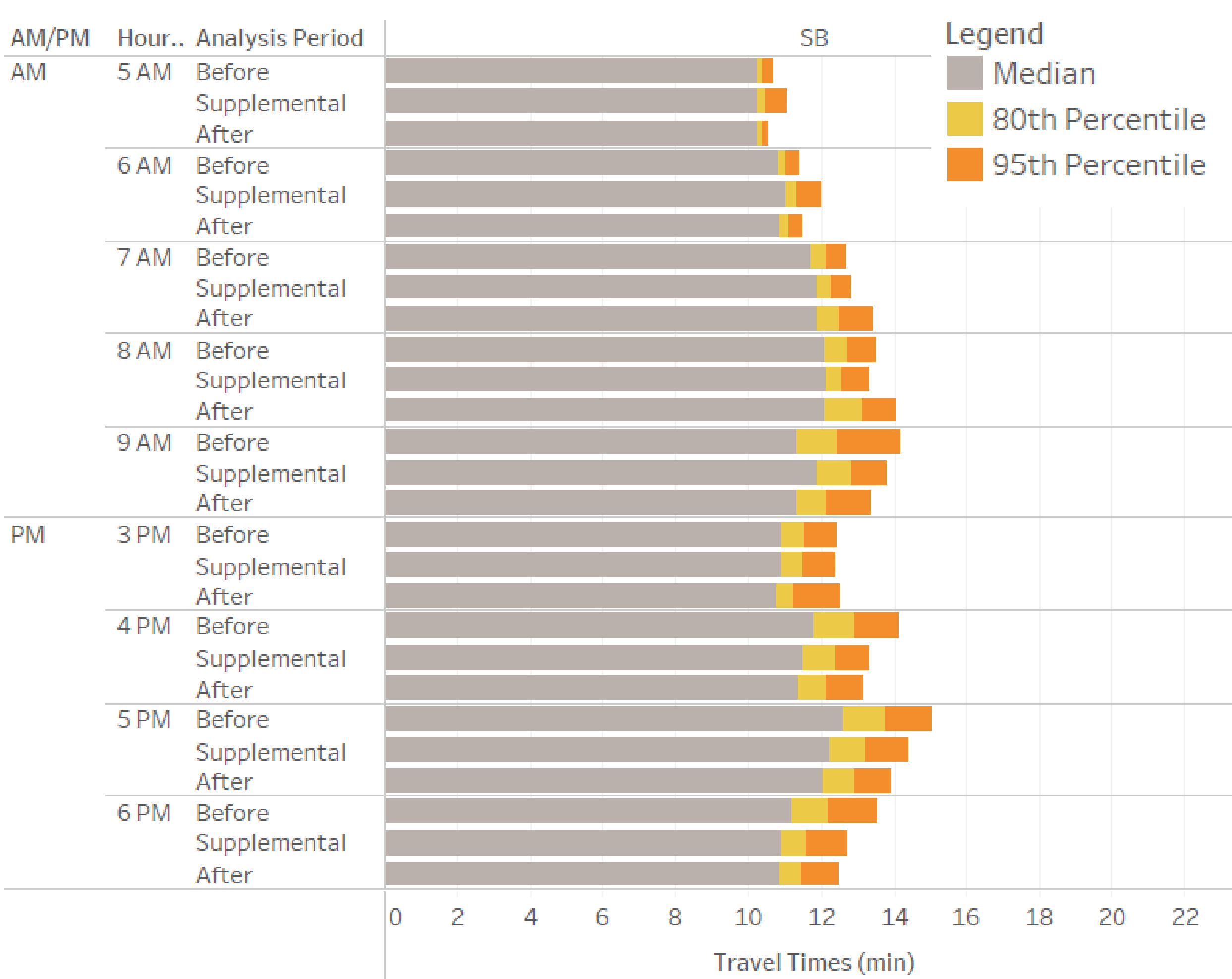
Source: Kittelson & Associates, Inc., based on 12 months of PeMS data for each study period.

As with the evaluation of all lanes, the poorest reliability in the HOV/Express lanes occurred in the northbound direction during the PM peak period. The 95th percentile travel times could be up to 60 percent higher than the median travel times. However, the reliability in the HOV/Express lanes was significantly better than in all lanes, where 95th percentile travel times could be nearly double the median travel times.

During most hours of the PM peak period, the reliability improved in the After conditions. However, in some hours of the AM peak period, the 95th percentile travel times were highest in the After conditions.

This occurred even though median travel times in the After study were very similar to Before conditions and generally improved from Supplemental Before conditions. This is consistent with most of the other performance measures, which were based on average conditions rather than 95th percentile conditions. The increases in 95th percentile travel times when median times stay constant could indicate more frequent freeway incidents during the 12 months used to represent the After conditions, and may not be directly related to the implementation of the express lane.

Figure 33: HOV/Express Lane Reliability, Southbound



Source: Kittelson & Associates, Inc., based on 12 months of PeMS data for each study period.

The HOV/Express lane was more reliable in the southbound direction than in the northbound direction, as indicated by 80th and 95th percentile travel times that were not significantly higher than median travel times. As in the northbound direction, the reliability in the After study was slightly worse during some hours of the AM peak period compared to the Before and Supplemental before conditions, but improved during most hours of the PM peak period.

6.10. MEASURE 10: MANAGED LANE SPEED ASSESSMENT

The managed lane speed assessment was based on PeMS data from the months of June to December, 2014 and 2018. This represents the 180 consecutive days specified in the statutory requirement. The measure was calculated from the available weekday data to provide an indication of the speed performance of the managed lane.

Average hourly speeds were computed at each PeMS detector location for each hour during HOV lane operation for each weekday. The percentage of hours operating at an average speed less than 45 miles per hour were tabulated and compared to the 10 percent threshold for identification of facility degradation (Table 36).

In the northbound direction, managed lane speeds of less than 45 mph were reported for more than 10 percent of peak period hours at two locations in the northern part of the corridor, Greenbrook Drive and Stone Valley Road. At Stone Valley Road, the percentage of hours at less than 45 mph improved from 30 percent in the 2014 Before study to 17 percent in the 2018 After study, indicating greater reliability of managed lane speeds in the After condition. The percentage of deficient hours northbound at Greenbrook Drive increased by 4 percent in the After conditions.

Managed lane speeds less than 45 mph were not reported for more than 10 percent of peak period hours at any of the 4 detector locations in the southbound direction. There was a small increase in the percentage of deficient hours southbound at Stone Valley Road, from 1 to 4 percent.

Overall, the managed lane speed assessment after the implementation of the express lanes improved significantly at the location that was most deficient in the Before conditions.

Table 36: Managed Lane Speed Assessment

	Total Peak Period Hours	Hours <45 mph	Percent of Hours <45 mph	>10%
NORTHBOUND				
Bollinger Canyon Road				
Before	632	2	0%	No
After	992	2	0%	No
Crow Canyon Road				
Before	1000	45	5%	No
After	992	9	1%	No
Greenbrook Drive				
Before	1000	125	**13%**	**YES**
After	992	168	**17%**	**YES**
Stone Valley Road				
Before	1000	296	**30%**	**YES**
After	992	168	**17%**	**YES**
SOUTHBOUND				
Stone Valley Road				
Before	1000	12	1%	No
After	992	39	4%	No
Sycamore Valley Road				
Before	1000	1	0%	No
After	992	1	0%	No
Greenbrook Drive				
Before	1000	2	0%	No
After	992	4	0%	No
Norris Canyon Road				
Before	1000	2	0%	No
After	992	10	1%	No

Source: PeMS data June-December 2014 and 2018 for hours of HOV operation (5-9 AM, 3-7 PM).
Deficient segments shown in bold and red shading.

6.11. MEASURE 11: VIOLATIONS

Express lane violations are defined as the number of counted single-occupant vehicles exceeding the number of single-occupant vehicles identified by the toll tag detector system, after accounting for clean air vehicles. Violations were estimated for four locations where toll tag information was provided. The violations are defined as the difference during periods when the number of vehicles counted as single-occupant vehicles in the manual occupancy counts, minus the counted clean air vehicles, exceeded the number of single-occupant vehicles reported by the toll system. Two days of data were averaged where reliable manual counts were available for most of the four-hour peak periods for both days, otherwise one day was reported (Table 37).

Table 37: Estimated Express Lane Violations

	Peak Period	SOV Count Volume	Express Lane Volume	Estimated Violations	Percent of SOVs	Percent of Express Lane
NORTHBOUND						
Crow Canyon Road	AM	1,320	2,100	100	12%	8%
	PM	1,690	2,640	220	10%	7%
Livorna Road	AM	1,420	2,730	110	8%	4%
	PM	2,230	3,790	220	10%	6%
SOUTHBOUND						
Alcosta Boulevard	AM	1,810	2,910	110	6%	4%
	PM	940	1,730	<10	1%	1%
Crow Canyon Road	AM	1,360	2,440	110	8%	5%
	PM	1,650	2,900	10	1%	0%

Notes:

1. SOV count volume and express lane volumes from manual occupancy counts factored to match toll tag detector count totals. Out of the 4 hour peak periods, totals are reported only for 15-minute periods where "unknown" vehicle occupancies were less than 50 percent of observations.
2. For northbound at Livorna Road, vehicle occupancy count percentages were from counts at Greenbrook Drive.
3. For southbound at Alcosta Boulevard, vehicle occupancy count percentages were from counts at Norris Canyon Road.
4. For southbound at Crow Canyon Road, vehicle occupancy count percentages were from counts at Greenbrook Drive.

The estimated violation rates were highest in the northbound direction, which is consistent with the higher congestion levels. Violations were estimated as 8 to 12 percent of counted SOVs, or 4 to 8 percent of total express lane volume. Lower violation rates of 4 to 5 percent were estimated southbound during the AM peak period, and very low violation rates of 1 percent or less were estimated for the southbound corridor during the PM peak period, when little congestion was reported.

7. CONTROL CORRIDOR PERFORMANCE MEASURES

Selected performance measures are reported for the control corridor, southbound I-680 between Willow Pass Road and Olympic Boulevard. These measures can be compared to the results for the study corridor to determine if study corridor results represent specific effects of the express lanes or regional trends.

IN THIS SECTION>>

- Results for performance measures on control corridor

7.1. MEASURE 1: TRAVEL TIME AND SPEED

Average travel times and speeds were calculated for each 15-minute time period for the I-680 control corridor (Table 38 and Table 39 and Figure 34). The travel times were based on INRIX data, which do not differentiate between HOV and general purpose lanes. Therefore, these travel times and speeds represent the averages for all vehicles.

Travel Times

In the 2014 Before study, travel times on the I-680 control corridor during the AM peak period varied from 5.2 minutes up to a maximum of 19.8 minutes. In the After study, the maximum travel time was reduced to 15.9 minutes, a reduction of 20 percent. Travel times during the PM peak period in the Before study were much less variable, with a minimum travel time of 5.4 minutes and a maximum travel time of 5.9 minutes. The After study reported maximum times of 6.1 minutes, a three percent increase.

As shown in Figure 34, travel times in the early part of the AM peak period (before 7:00 AM) were slightly higher in the Supplemental Before and After studies than in the Before study, indicating general increases in congestion in the early morning. However, the maximum peak travel times were consistently lower in the After study. This indicates either an improvement in operating conditions and/or a general decrease in demand during the peak of the AM peak period.

The INRIX data do not report separate travel times for HOV lanes and general purpose lanes. Therefore, travel time savings on the HOV lane are not reported for the control corridor.

Travel Speeds

The average travel speeds on the control corridor were above 60 mph in the early part of the AM peak period (before 5:45 AM) and the end of the AM peak period (after 9:30 AM) in all three measurement periods. Slower speeds occurred earlier in the morning (before 6:30 AM) in the After study. However, the slowest AM speeds increased from 18 mph in the Before study to 22 mph in the After study. This may indicate that some drivers have shifted their time of travel to earlier in the peak period to avoid congestion.

Table 38: Median Travel Times and Speeds, AM Peak Period, Control Corridor

	Travel Time (Minutes)			Speed (Miles per Hour)		
Time	Before (2014)	Supp. Before (2017)	After (2018)	Before (2014)	Supp. Before (2017)	After (2018)
5:00 AM	5.2	5.3	5.1	69	67	70
5:15 AM	5.3	5.4	5.3	68	66	67
5:30 AM	5.3	5.6	5.5	67	63	65
5:45 AM	5.4	6.3	5.9	65	56	60
6:00 AM	5.5	7.6	7.4	65	47	48
6:15 AM	6.0	9.9	9.1	59	36	39
6:30 AM	8.3	11.8	10.8	43	30	33
6:45 AM	10.2	13.3	11.7	35	27	30
7:00 AM	11.2	13.2	12.4	32	27	29
7:15 AM	12.8	14.8	14.4	28	24	25
7:30 AM	15.4	17.9	**15.9**	23	20	22
7:45 AM	**19.8**	**18.5**	15.8	18	19	23
8:00 AM	18.8	17.1	13.9	19	21	26
8:15 AM	16.2	15.3	13.8	22	23	26
8:30 AM	15.2	13.9	12.9	23	26	28
8:45 AM	13.4	12.0	12.9	27	30	28
9:00 AM	8.8	10.3	9.5	40	35	37
9:15 AM	7.1	7.4	7.0	50	48	51
9:30 AM	5.8	5.8	5.9	61	61	60
9:45 AM	5.6	5.7	5.8	63	62	61

Source: Based on 12 months of INRIX data for each study period.

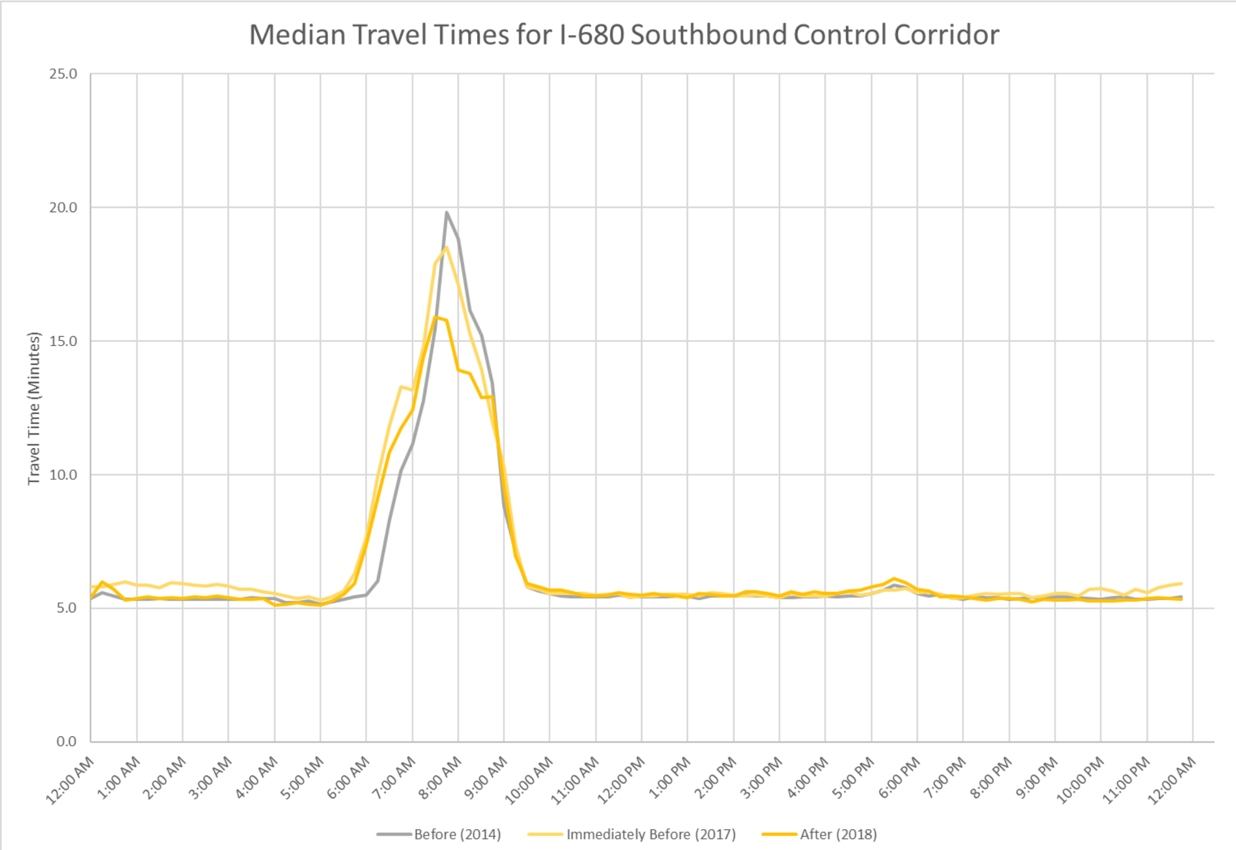
Average speeds during the PM peak period were consistently above 60 mph during all measurement periods, except for a lower speed of 58 mph for the After conditions at 5:30 PM. This indicates a small increase in congestion during the peak of the PM peak period.

Table 39: Median Travel Times and Speeds, PM Peak Period, Control Corridor

	Travel Time (Minutes)			Speed (Miles per Hour)		
Time	Before (2014)	Supp. Before (2017)	After (2018)	Before (2014)	Supp. Before (2017)	After (2018)
3:00 PM	5.4	5.4	5.5	66	66	65
3:15 PM	5.4	5.6	5.6	66	64	64
3:30 PM	5.4	5.5	5.5	66	65	64
3:45 PM	5.4	5.5	5.6	66	65	63
4:00 PM	5.5	5.5	5.6	65	65	64
4:15 PM	5.4	5.6	5.6	66	64	64
4:30 PM	5.5	5.6	5.6	65	64	63
4:45 PM	5.5	5.5	5.7	65	65	63
5:00 PM	5.5	5.5	5.8	64	64	61
5:15 PM	5.7	5.7	5.9	63	63	60
5:30 PM	**5.9**	5.7	**6.1**	61	63	58
5:45 PM	5.8	**5.8**	6.0	62	62	60
6:00 PM	5.6	5.6	5.7	64	64	62
6:15 PM	5.5	5.6	5.7	65	63	63
6:30 PM	5.5	5.5	5.4	65	64	65
6:45 PM	5.4	5.4	5.5	66	66	65

Source: Based on 12 months of INRIX data for each study period.

Figure 34: Median Travel Times, Control Corridor



Notes:
I-680 Southbound between Willow Pass Rd and Olympic Blvd, approximately 5.9 miles
Source: INRIX

7.2. MEASURE 2: DELAY

Delay is measured as the difference between actual observed travel times and the free-flow travel times under uncongested conditions at 65 miles per hour. Total delay was calculated for each 15-minute period during the AM and PM peak periods on the I-680 control corridor (Table 40).

Between the Before and After studies, delays increased during the early part of the peak period (5:45 to 7:30 AM) but the maximum delays decreased after 7:30 AM. No significant delays were reported during the PM peak period, but there were small increases in delays during the PM peak period in the After study.

Table 40: Average Delay (Minutes), Control Corridor

Time	Free Flow Travel Time	Before (2014)	Supp. Before (2017)	After (2018)
5:00 AM	8.4	0.0	0.0	0.0
5:15 AM	8.4	0.0	0.0	0.0
5:30 AM	8.4	0.0	0.2	0.0
5:45 AM	8.4	0.0	0.8	0.4
6:00 AM	8.4	0.0	2.2	1.9
6:15 AM	8.4	0.5	4.5	3.7
6:30 AM	8.4	2.8	6.4	5.4
6:45 AM	8.4	4.7	7.8	6.2
7:00 AM	8.4	5.7	7.7	6.9
7:15 AM	8.4	7.3	9.3	8.9
7:30 AM	8.4	10.0	12.4	**10.4**
7:45 AM	8.4	**14.3**	**13.0**	10.3
8:00 AM	8.4	13.3	11.6	8.4
8:15 AM	8.4	10.7	9.8	8.3
8:30 AM	8.4	9.7	8.5	7.4
8:45 AM	8.4	8.0	6.5	7.5
3:00 PM	8.4	0.0	0.0	0.0
3:15 PM	8.4	0.0	0.1	0.1
3:30 PM	8.4	0.0	0.0	0.1
3:45 PM	8.4	0.0	0.0	0.2
4:00 PM	8.4	0.0	0.0	0.1
4:15 PM	8.4	0.0	0.1	0.1
4:30 PM	8.4	0.0	0.1	0.2
4:45 PM	8.4	0.0	0.0	0.2
5:00 PM	8.4	0.1	0.1	0.3
5:15 PM	8.4	0.2	0.2	0.4
5:30 PM	8.4	**0.4**	0.2	**0.6**
5:45 PM	8.4	0.3	**0.3**	0.5
6:00 PM	8.4	0.1	0.1	0.2
6:15 PM	8.4	0.0	0.1	0.2
6:30 PM	8.4	0.0	0.1	0.0
6:45 PM	8.4	0.0	0.0	0.0

I-680 Southbound between Willow Pass Rd and Olympic Blvd, approximately 5.9 miles
Free flow travel time is equal to travel time at 65 mph.
Delay is the difference between average travel time and free flow travel time, minimum of zero.
Source: INRIX

7.3. MEASURE 3: BOTTLENECKS, QUEUES AND DURATION

Bottleneck locations and queue lengths were identified for the I-680 control corridor based on the INRIX data. Separate information was not available for the HOV and general purpose lanes. The queues and bottleneck locations in all lanes on the control corridor are summarized in Table 21.

Table 41: Bottleneck and Queue Locations, Lengths and Durations, Control Corridor

Time and Direction	Before (2014)	Supp. Before (2017)	After (2018)
AM PEAK PERIOD			
Southbound	Sun Valley to SR 24 4.4 miles 3.0 hours	Monument to SR 24 3.8 miles 3.5 hours	Monument to Ygnacio On 4.2 miles 3.5 hours
PM PEAK PERIOD			
Southbound	No bottlenecks	No bottlenecks	No bottlenecks

Source: Kittelson & Associates, Inc. based on INRIX data

Queues on southbound I-680 approaching the SR 24 interchange were observed during all three study periods during the AM peak period. The queue started slightly further south at Monument Boulevard in the Supplemental Before and After studies. No significant congestion was reported in the PM peak period.

Duration of Congestion

Queuing on the southbound I-680 control corridor was observed from 6:30 to 9:30 AM in the Before study, but started one half hour earlier in the Supplemental Before and After studies. No significant congestion was reported in the PM peak period.

7.4. MEASURE 4: VEHICLE OCCUPANCY AND CLASSIFICATION

Vehicle occupancy is reported at the one manual vehicle occupancy survey location on the control corridor, at the Oak Park Boulevard overcrossing. The vehicle occupancy is reported only for the hours when occupancies could be reliably observed and HOV lanes were in operation.

Vehicle Occupancy

Average vehicle occupancies for the AM and PM peak periods are summarized in Table 42.

Table 42: Throughput and Average Vehicle Occupancies, I-680 Southbound at Oak Park Boulevard

Location & Lane Type	Before (2014)			After (2018)		
	Vehicle Throughput	Person Throughput	Average Vehicle Occupancy	Vehicular Throughput	Person Throughput	Average Vehicle Occupancy
AM PEAK PERIOD (6:30 – 9:00 AM)						
Oak Park Boulevard						
HOV/Express	3,140	5,990	1.91	3,600	8,180	2.28
General Purpose	16,770	21,870	1.30	18,700	22,340	1.19
Total	**19,910**	**27,860**	**1.40**	**22,300**	**30,520**	**1.37**
PM PEAK PERIOD (3:00 – 6:00 PM)						
Oak Park Boulevard						
HOV/Express	1,100	2,100	1.91	2,240	4,870	2.17
General Purpose	23,130	27,880	1.21	24,280	29,280	1.21
Total	**24,230**	**29,980**	**1.24**	**26,520**	**34,150**	**1.29**

Sources: PeMS, manual vehicle occupancy counts by IDAX Data Solutions, 3/8/18 and 4/10/18

The average vehicle occupancy (AVO) for the HOV lane was 1.91 during both peak periods in the Before study; the value less than 2.0 indicates a relatively high number of single occupant vehicles (electric vehicles, etc…) relative to higher occupancy vehicles using the HOV lane in the control corridor. The reported AVOs in the HOV lane increased in the After study survey. It is unknown if this change was due to an increase in HOV usage or a change in survey methodology.

The AVO in the general purpose lanes decreased from the Before to the After study in the AM peak period and remained constant in the PM peak period. The overall AVO for all lanes decreased by two percent in the AM peak period and increased by four percent in the PM peak period. Therefore, there was no constant trend of increased or decreased high-occupancy vehicle usage in the control corridor.

Vehicle Classification

The vehicle classification surveys for the control corridor are summarized in Table 43.

Table 43: Vehicle Classification Surveys, I-680 Southbound at Oak Park Boulevard

	HOV Lane	HOV Lane	GP Lanes	GP Lanes	All Lanes	All Lanes
	Before (2014)	After (2018)	Before (2014)	After (2018)	Before (2014)	After (2018)
AM PEAK PERIOD (6:30 – 9:00 AM)						
SOV	24%	26%	82%	82%	73%	73%
HOV 2	66	62	12	13	20	21
HOV 3+	4	5	<1	1	<1	1
Motorcycles	3	1	<1	<1	<1	<1
Heavy Vehicles	2	4	5	4	5	4
Buses	<1	2	<1	<1	<1	<1
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Clean Air Vehicles	n/a	7%	n/a	n/a	n/a	n/a
PM PEAK PERIOD (3:00 – 6:00 PM)						
SOV	34%	31%	78%	82%	76%	77%
HOV 2	55	61	13	15	15	19
HOV 3+	6	4	<1	1	1	2
Motorcycles	3	1	<1	<1	<1	<1
Heavy Vehicles	<1	2	6	2	6	2
Buses	<1	1	<1	<1	<1	<1
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Clean Air Vehicles	n/a	7%	n/a	n/a	n/a	n/a

Source: Manual vehicle occupancy counts by IDAX Data Solutions, 3/8/18 and 4/10/18

Vehicle classifications in the AM peak period stayed relatively constant between the Before and After studies. In the PM peak period, there was a decrease in single occupant vehicles (SOVs) in the HOV lane and an increase in SOVs in the general purpose lanes. As a result, the classifications for all lanes in total were very similar between the Before and After studies. As with the AVOs, the vehicle classification surveys indicate no clear trend of increased or decreased HOV usage during the study period.

7.5. MEASURE 5: VEHICLE THROUGHPUT

Throughput on the I-680 control corridor was tabulated for the hours of the peak period when vehicle occupancies could be reliably surveyed (Table 42, page 93). The AM peak period throughput is reported from 6:30 to 9:00 AM and the PM peak period throughput is reported from 3:00 to 6:00 PM.

Vehicle throughput in the HOV lane increased by 15 percent in the 2.5 hour AM peak period (from 3,140 to 3,600) and doubled in the three hour PM peak period (from 1,100 to 2,240). In the general purpose lanes, vehicle throughput increased by 12 percent in the AM peak period (from 16,770 to 18,700) and by five percent in the PM peak period (from 23,130 to 24,280). Total vehicle throughput in all lanes increased by 12 percent in the AM peak period and by 9 percent in the PM peak period. This indicates a general increase in traffic activity in the area, consistent with the increased vehicle throughput in the north part of the study corridor but not consistent with the decreases in throughput in the south part of the study corridor.

7.6. MEASURE 6: PERSON THROUGHPUT

Person throughput on the I-680 control corridor was tabulated for the hours of the peak period when vehicle occupancies could be reliably surveyed (Table 42, page 93).

Person throughput in the HOV lane increased by 37 percent in the 2.5 hour AM peak period (from 5,990 to 8,180) and by 232 percent in the three hour PM peak period (from 2,100 to 4,870). In the general purpose lanes, person throughput increased by two percent in the AM peak period (from 21,870 to 22,340) and by five percent in the PM peak period (from 27,880 to 29,280). Overall person throughput in all lanes increased by 10 percent in the AM peak period and by 5 percent in the PM peak period. As with the vehicle throughput, these increases are consistent with trends in the north part of the study corridor.

7.7. MEASURE 7: VEHICLE HOURS OF DELAY

Vehicle-hours of delay were not calculated for the I-680 control corridor. The detailed segment traffic volumes required for this calculation were not included in the available data.

7.8. MEASURE 8: LEVEL OF SERVICE

Level of service was not calculated for the I-680 control corridor. The available INRIX data did not provide separate speeds at the detailed segment level for HOV and general purpose lanes.

7.9. MEASURE 9: TRAVEL TIME RELIABILITY

The Planning Time Index and Travel Time Index were calculated for the control corridor (Table 44, Figure 35 and Figure 36). The available INRIX data were used to calculate reliability measures for all lanes combined on the control corridor.

The travel time variability on the control corridor was much higher than on the study corridor. The median travel times during the AM peak hours (7:00 to 9:00 AM) were nearly three times the free-flow travel times (TTI of 3.00). The 95th percentile travel times were up to more than five times greater than free-flow travel times (PTI) during the Before study. This indicates both high levels of recurrent congestion during the AM peak period as well as a high likelihood of incident delays (non-recurrent congestion). Several of these values worsened during the 2017 Supplemental Before study period. However, the After study reliability measures generally improved compared to the Before and Supplemental Before conditions.

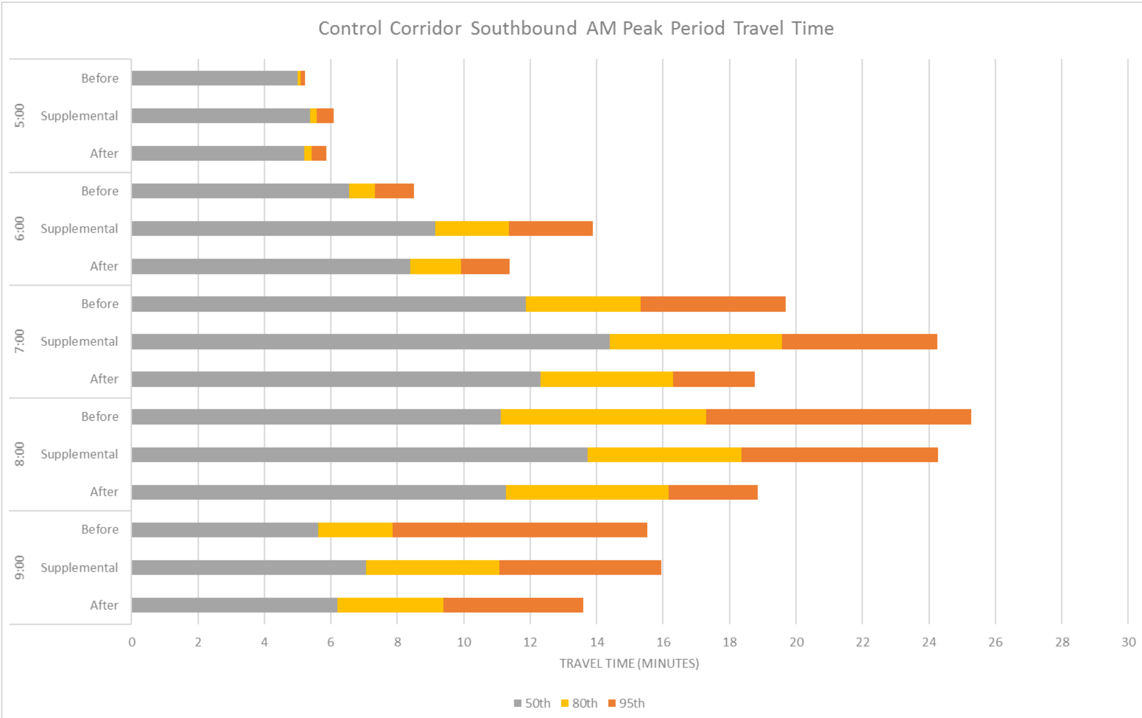
Table 44: All Lanes Reliability Measures, Control Corridor

Time	Study	Travel Time 50th Percentile	Travel Time 95th Percentile	Travel Time Index	Planning Time Index
5:00 AM	Before	5.01	5.23	1.02	1.06
	Supplemental	5.38	6.08	1.09	1.24
	After	5.20	5.88	1.06	1.19
6:00 AM	Before	6.56	8.50	1.33	1.73
	Supplemental	9.14	13.89	1.86	2.82
	After	8.38	11.39	1.70	2.31
7:00 AM	Before	11.87	19.69	2.41	4.00
	Supplemental	14.40	24.25	2.92	4.93
	After	12.31	18.75	2.50	3.81
8:00 AM	Before	11.13	25.27	2.26	5.13
	Supplemental	13.72	24.28	2.79	4.93
	After	11.28	18.85	2.29	3.83
9:00 AM	Before	5.61	15.53	1.14	3.15
	Supplemental	7.05	15.95	1.43	3.24
	After	6.19	13.60	1.26	2.76
3:00 PM	Before	5.22	5.45	1.06	1.11
	Supplemental	5.23	6.19	1.06	1.26
	After	5.18	5.69	1.05	1.16
4:00 PM	Before	5.21	5.73	1.06	1.16
	Supplemental	5.23	6.21	1.06	1.26
	After	5.21	6.81	1.06	1.38
5:00 PM	Before	5.29	7.85	1.07	1.60
	Supplemental	5.29	7.86	1.07	1.60
	After	5.26	8.75	1.07	1.78
6:00 PM	Before	5.20	6.17	1.06	1.25
	Supplemental	5.12	5.92	1.04	1.20
	After	5.02	6.17	1.02	1.25

Notes:
Travel Time Index (TTI) = 50th percentile travel time / free-flow travel time
Planning Time Index (PTI) = 95th percentile travel time / free-flow travel time
Source: Kittelson & Associates, Inc. based on INRIX data

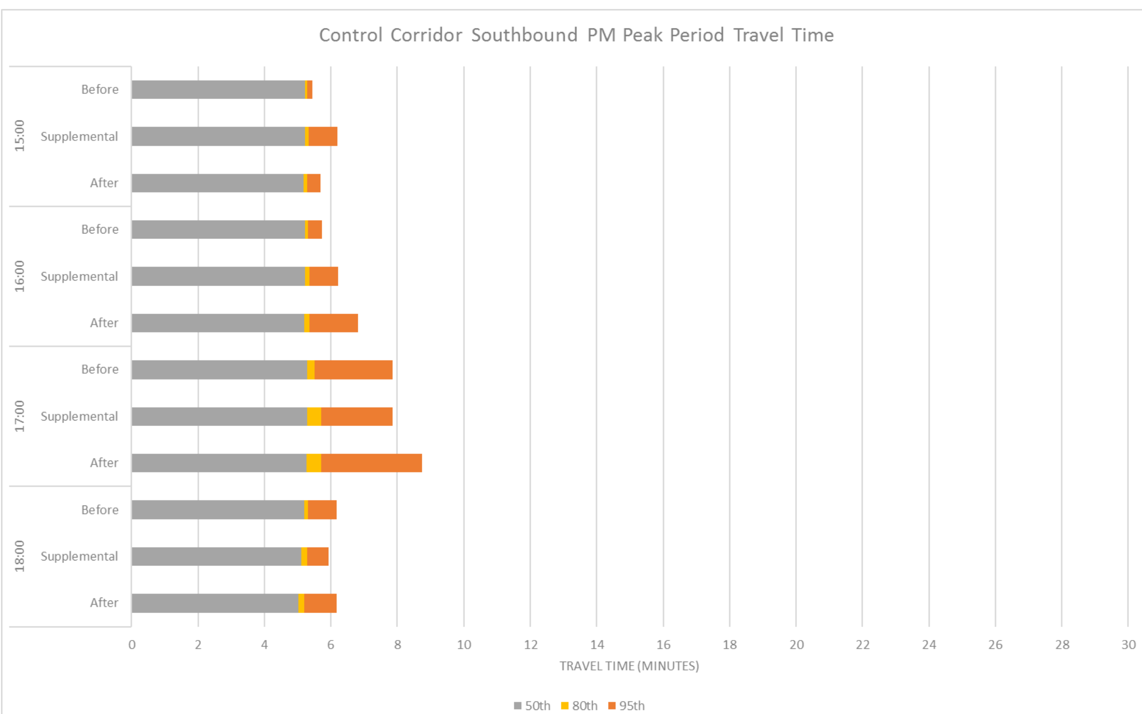
The PM peak period reliability measures (TTI and PTI) had median travel times no more than 10 percent higher than free-flow travel times and maximum expected times (indicated by PTI) up to about 80 percent higher than the free-flow travel times.

Figure 35: Median, 80th and 95th Percentile Travel Times, Control Corridor, AM Peak Period



Source: Kittelson & Associates, Inc. based on INRIX data

Figure 36: Median, 80th and 95th Percentile Travel Times, Control Corridor, PM Peak Period



Source: Kittelson & Associates, Inc. based on INRIX data

7.10. MEASURE 10: MANAGED LANE SPEED ASSESSMENT

The managed lane speed assessment measure was not calculated for the I-680 control corridor. This measure requires travel time measurements for multiple days and hours separately for the managed (HOV) lane. The INRIX data for the control corridor do not provide separate travel times for the HOV lane and the general purpose lanes.

7.11. MEASURE 11: VIOLATIONS

Violation rates were not assessed for the control corridor, as toll systems are not yet implemented.

8. CONCLUSIONS

The conclusions of the Before/After study are based on the evaluation of the study corridor performance measures and comparison to results on the control corridor.

8.1. MEASURE 1: TRAVEL TIMES AND SPEEDS

Travel Times

- Travel times in both the HOV/Express lanes and general purpose lanes generally stayed constant or decreased after the implementation of express lanes.
- The maximum travel times, northbound during the PM peak period, decreased significantly between the 2014 Before study and the 2017 Supplemental Before study, and then decreased slightly during the 2018 After study.

Travel Time Savings

- Maximum travel time savings in the HOV/Express lane compared to the general purpose lanes were 9 minutes in the Before study, 4 minutes in the Supplemental Before study and 6 minutes in the After study. The express lane travel times in the After study were not slower than in the Supplemental Before study, but the general purpose lane travel times had improved comparatively.

Speeds

- The slowest speed conditions improved from the Before to the After conditions, for both the HOV/Express and general purpose lanes.
- In the HOV/Express lane, minimum speeds northbound during the PM peak period dropped below 30 mph in the Before study but stayed above 45 mph in the After study.
- The general purpose lane minimum speeds in the Before study were close to 20 mph, but generally stayed above 30 mph in the Supplemental Before and above 35 mph in the After study.

8.2. MEASURE 2: DELAY

- The northbound HOV lane had significant delays of up to 9 minutes in the PM peak period in the Before study. This decreased to 4 minutes in the Supplemental Before study and 3 minutes in the express lane in the After study.
- Maximum northbound PM general purpose lane delays decreased from 17 minutes in the Before study to about 7 to 8 minutes in the Supplemental Before and After studies.
- HOV/Express lane delays in the AM peak period and southbound in the PM peak period remained typically at one minute or less.

8.3. MEASURE 3: BOTTLENECKS, QUEUES AND DURATION OF CONGESTION

- During the AM peak period in the Before Study, there were no significant queues (defined as traffic moving at less than 35 mph) reported on the HOV lanes.
- In the After study, there were queues in the southbound express lane from Rudgear Road to Livorna Road during the peak 0.5 hours of the AM peak period.
- In the northbound PM peak period, a 7 mile HOV lane queue from Livorna Road lasting 2 hours in the Before study decreased to a 3.4 mile express lane queue lasting 1 hour in the After study.
- The implementation of the express lanes did not appear to significantly shorten or lengthen queues in the general purpose lanes.

8.4. MEASURE 4: VEHICLE OCCUPANCY AND CLASSIFICATION

- In all locations, the average vehicle occupancies (AVO) in the HOV/Express lane decreased from values of 1.9 or more in the HOV lane to values of less than 1.8 after implementation of the express lane.
- The total AVO for all lanes increased at one of seven survey location, stayed constant at two locations and decreased at four locations during both the AM and PM peak periods.

8.5. MEASURE 5: VEHICLE THROUGHPUT

- In general, vehicle throughput in HOV/Express lane increased in the AM peak period and decreased in the PM peak period after implementation of express lanes.
- Decreases in vehicle throughput were primarily in the less congested south part of the corridor, while increases were most significant in the congested north part of the corridor. The reasons for the decrease appear to be related to changes in activity in the San Ramon area rather than freeway operating conditions.

8.6. MEASURE 6: PERSON THROUGHPUT

- The total person throughput for the two-hour peak periods at all seven survey locations combined results in a 1.4 percent increase in total person throughput for the AM peak period and a 3.8 percent reduction in total person throughput in the PM peak period.
- The largest increase in person throughput occurred at Greenbrook Drive northbound in the PM peak period (+1,760 or +13%).
- The largest decrease in person throughput occurred northbound at Alcosta Boulevard in the PM peak period (-3,640 or -26% in the two-hour period.

8.7. MEASURE 7: VEHICLE-HOURS OF DELAY

- Conditions after the implementation of the express lanes resulted in significant decreases in total peak period vehicle-hours of delay (VHD) compared to Before conditions.
- There was a reduction of 62 percent in total (AM+PM) peak period VHD in the HOV/express lane, an 18 percent reduction in the general purpose lanes, and a 25 percent overall reduction in peak period delay.
- There was a 26 percent increase in total delay southbound during the PM peak period, but the magnitude of this increase was less than the magnitude of the decreases in delay for other directions and time periods.

8.8. MEASURE 8: LEVEL OF SERVICE

- Freeway level of service generally improved after the implementation of express lanes for both the HOV/Express lanes and the general purpose lanes.

8.9. MEASURE 9: TRAVEL TIME RELIABILITY

- Reliability improved for the most congested conditions, northbound during the PM peak period, after the implementation of express lanes.
- The express lane implementation did not have a consistent effect on reliability measures during the AM peak period or southbound during the PM peak period.
- During the PM peak period, the HOV/Express lane reliability improved in the After conditions.
- In the AM peak period, the HOV/Express lane 95th percentile travel times were highest in the After conditions even though median travel times were very similar to Before conditions. This may be related to higher observed vehicle volumes.

8.10. MEASURE 10: MANAGED LANE SPEED ASSESSMENT

- The managed lane speed assessment after the implementation of the express lane improved significantly at the location that was most deficient in the Before conditions, from 30 percent of hours less than 45 mph to 17 percent of hours less than 45 mph.

8.11. MEASURE 11: VIOLATIONS

- The maximum estimated violations, defined as the number of single-occupant vehicles (SOV) in the express lane based on manual counts exceeding the number of SOVs recorded by the toll system for the same time period) were in the northbound direction during the PM peak period. The violation rates were estimated as 10 to 13 percent of SOVs or 6 to 8 percent of total express lane volume.

- AM peak violation rates were 6 to 8 percent of SOVs or 4 to 5 percent of total express lane volume.
- Few violations were estimated southbound in the PM peak period.

APPENDIX A: FREEWAY SPEED CONTOURS

Speed contour charts were created based on the floating car surveys and INRIX data (Figure 37 to Figure 44). The speed contour charts show the median (50th percentile) speed in each segment of the freeways. The speeds are color coded as follows:

Green	Greater than 55 mph
Yellow	45 to 55 mph
Orange	35 to 45 mph
Red	Less than 35 mph

Figure 37: Speed Contours, I-680 Study Corridor Northbound, Before Study (2014)

I-680 Northbound 50th Percentile Speeds Before Study (2014)

Target Time	I-580 Off-Ramp to I-580 On-Ramp	I-580 On-Ramp to Village Pkwy On-Ramp	Village Pkwy On-Ramp to West of Canterbury Ln	West of Canterbury Ln to Alcosta Blvd Off-Ramp	Alcosta Blvd Off-Ramp to Alcosta Blvd On-Ramp	Alcosta Blvd On-Ramp to West of Winthrop Ave	West of Winthrop Ave to West of Pine Valley Rd	West of Pine Valley Rd to West of Waterbury Way	West of Waterbury Way to West of Soccer Fields	West of Soccer Fields to Bollinger Canyon Rd Off-Ramp	Bollinger Canyon Rd Off-Ramp to Bollinger Canyon Rd Loop On-Ramp	Bollinger Canyon Rd Loop On-Ramp to Bollinger Canyon Rd Diag. On-Ramp	Bollinger Canyon Rd Diag. On-Ramp to Crow Canyon Rd Off-Ramp	Crow Canyon Rd Off-Ramp to Crow Canyon Rd Loop On-Ramp	Crow Canyon Rd Loop On-Ramp to Crow Canyon Rd Diag On-Ramp	Crow Canyon Rd Diag On-Ramp to West of Mission Pl	West of Mission Pl to West of Delta Way	West of Delta Way to Sycamore Valley Rd Off-Ramp	Sycamore Valley Rd Off-Ramp to Sycamore Valley Rd On-Ramp	Sycamore Valley Rd On-Ramp to Diablo Rd Off-Ramp	Diablo Rd Off-Ramp to Diablo Rd Loop On-Ramp	Diablo Rd Loop On-Ramp to Diablo Rd Diag On-Ramp	Diablo Rd Diag On-Ramp to El Cerro Blvd Off-Ramp	El Cerro Blvd Off-Ramp to El Cerro Blvd On-Ramp	El Cerro Blvd On-Ramp to El Rio Rd On-Ramp	El Rio Rd On-Ramp to North of Alamo Springs Dr	North of Alamo Springs Dr to Stone Valley Rd Diag Off-Ramp	Stone Valley Rd Diag Off-Ramp to Stone Valley Rd Loop Off-Ramp	Stone Valley Rd Loop Off-Ramp to Stone Valley Rd On-Ramp	Stone Valley Rd On-Ramp to Livorna Rd Off-Ramp	Livorna Rd Off-Ramp to Livorna Rd On-Ramp	Livorna Rd On-Ramp to Rudgear Rd Off-Ramp	Rudgear Rd Off-Ramp to Danville Blvd On-Ramp	Danville Blvd On-Ramp to Main St Off-Ramp	Main St Off-Ramp to S Main St
12:00 AM	53.0	67.0	67.0	65.0	65.0	65.0	65.0	65.0	65.0	67.0	67.0	66.0	67.0	66.0	66.0	67.0	66.0	67.0	67.0	67.0	66.0	67.0	66.0	66.0	67.0	68.0	67.0	68.0	67.0	66.0	67.0	66.0	68.0	68.0	55.0
12:15 AM	53.0	61.0	62.0	63.0	64.0	64.0	64.0	65.0	65.0	65.0	66.0	64.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	64.0	64.0	65.0	64.0	65.0	66.0	66.0	66.0	66.0	65.0	65.0	64.0	65.0	66.0	65.0	55.0
12:30 AM	53.0	65.0	65.0	65.0	65.0	65.0	65.0	64.0	65.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	67.0	66.0	66.0	67.0	66.0	66.0	66.0	65.0	67.0	67.0	55.0
12:45 AM	53.0	67.0	67.0	66.0	66.0	67.0	66.0	65.0	66.0	67.0	67.0	66.0	67.0	66.0	66.0	67.0	66.0	67.0	67.0	66.0	66.0	67.0	66.0	67.0	67.0	68.0	67.0	67.0	67.0	66.0	66.0	65.0	69.0	69.0	55.0
1:00 AM	53.0	66.0	66.0	65.0	65.0	66.0	66.0	64.0	66.0	67.0	66.0	66.0	67.0	66.0	66.0	66.0	66.0	66.0	67.0	66.0	66.0	67.0	66.0	67.0	68.0	68.0	67.0	67.0	67.0	67.0	67.0	66.0	69.0	69.0	55.0
1:15 AM	53.0	66.0	66.0	65.0	65.0	66.0	65.0	64.0	66.0	66.0	67.0	66.0	67.0	65.0	66.0	67.0	66.0	66.0	67.0	66.0	66.0	67.0	66.0	67.0	67.0	67.0	67.0	67.0	66.0	65.0	65.0	66.0	68.0	68.0	55.0
1:30 AM	53.0	65.0	65.0	65.0	65.0	66.0	65.0	65.0	66.0	66.0	66.0	66.0	67.0	66.0	66.0	67.0	66.0	66.0	67.0	66.0	66.0	67.0	66.0	67.0	67.0	67.0	66.0	67.0	66.0	66.0	66.0	65.0	68.0	68.0	55.0
1:45 AM	53.0	66.0	66.0	65.0	65.0	66.0	65.0	64.0	65.0	66.0	66.0	66.0	67.0	66.0	66.0	67.0	65.0	66.0	67.0	66.0	66.0	67.0	66.0	67.0	67.0	67.0	67.0	66.0	66.0	65.0	65.0	64.0	67.0	67.0	55.0
2:00 AM	53.0	67.0	67.0	65.0	65.0	66.0	66.0	65.0	66.0	66.0	66.0	66.0	67.0	66.0	66.0	67.0	66.0	67.0	67.0	66.0	66.0	67.0	66.0	67.0	67.0	67.0	66.0	67.0	66.0	66.0	66.0	65.0	67.0	68.0	55.0
2:15 AM	53.0	67.0	67.0	65.0	66.0	66.0	66.0	64.0	66.0	66.0	67.0	66.0	67.0	66.0	66.0	67.0	66.0	67.0	67.0	66.0	66.0	67.0	66.0	67.0	68.0	68.0	67.0	67.0	66.0	66.0	66.0	65.0	68.0	68.0	55.0
2:30 AM	53.0	66.0	67.0	66.0	66.0	66.0	66.0	64.0	66.0	66.0	67.0	66.0	67.0	66.0	66.0	67.0	66.0	67.0	67.0	66.0	66.0	67.0	66.0	67.0	67.0	67.0	67.0	67.0	66.0	66.0	66.0	65.0	69.0	68.0	55.0
2:45 AM	53.0	67.0	68.0	65.0	65.0	66.0	65.0	64.0	65.0	66.0	66.0	66.0	67.0	66.0	66.0	67.0	66.0	67.0	67.0	66.0	66.0	66.0	66.0	66.0	67.0	67.0	66.0	67.0	66.0	65.0	66.0	65.0	68.0	68.0	55.0
3:00 AM	53.0	66.0	67.0	65.0	65.0	65.0	65.0	64.0	65.0	66.0	66.0	66.0	66.0	65.0	66.0	67.0	66.0	66.0	66.0	66.0	66.0	66.0	65.0	66.0	67.0	67.0	66.0	67.0	66.0	65.0	66.0	64.0	67.0	68.0	55.0
3:15 AM	53.0	66.0	67.0	65.0	65.0	66.0	65.0	64.0	66.0	66.0	66.0	66.0	67.0	66.0	66.0	67.0	66.0	67.0	66.0	66.0	66.0	66.0	65.0	67.0	67.0	67.0	66.0	67.0	66.0	66.0	66.0	65.0	67.0	68.0	55.0
3:30 AM	53.0	67.0	67.0	65.0	65.0	66.0	65.0	64.0	66.0	66.0	66.0	67.0	67.0	66.0	66.0	67.0	66.0	67.0	67.0	66.0	66.0	67.0	65.0	67.0	67.0	67.0	66.0	67.0	66.0	66.0	67.0	65.0	67.0	68.0	55.0
3:45 AM	53.0	66.0	67.0	65.0	64.0	65.0	65.0	64.0	65.0	66.0	66.0	66.0	67.0	66.0	66.0	66.0	65.0	66.0	67.0	66.0	66.0	66.0	65.0	67.0	67.0	67.0	66.0	67.0	66.0	65.0	66.0	65.0	67.0	68.0	55.0
4:00 AM	53.0	65.0	66.0	65.0	65.0	64.0	64.0	64.0	65.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	65.0	65.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	65.0	66.0	64.0	66.0	66.0	55.0
4:15 AM	50.0	64.0	65.0	64.0	64.0	65.0	64.0	64.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	66.0	65.0	65.0	66.0	65.0	66.0	66.0	66.0	65.0	66.0	65.0	65.0	65.0	65.0	66.0	67.0	65.0
4:30 AM	50.0	65.0	66.0	64.0	65.0	65.0	64.0	64.0	66.0	66.0	66.0	65.0	66.0	66.0	66.0	67.0	66.0	67.0	67.0	66.0	66.0	66.0	66.0	66.0	67.0	66.0	66.0	66.0	66.0	65.0	66.0	65.0	66.0	66.0	65.0
4:45 AM	49.0	65.0	68.0	66.0	66.0	67.0	66.0	65.0	67.0	67.0	67.0	67.0	67.0	67.0	67.0	67.0	67.0	67.0	67.0	66.0	66.0	67.0	67.0	66.0	66.0	67.0	67.0	67.0	67.0	66.0	67.0	67.0	69.0	68.0	65.0
5:00 AM	48.0	66.0	68.0	67.0	67.0	67.0	66.0	66.0	66.0	67.0	67.0	67.0	67.0	67.0	66.0	67.0	65.0	65.0	66.0	67.0	66.0	67.0	66.0	68.0	68.0	67.0	67.0	67.0	66.0	66.0	67.0	66.0	67.0	67.0	64.0
5:15 AM	45.0	66.0	67.0	66.0	66.0	66.0	66.0	65.0	66.0	67.0	67.0	67.0	67.0	67.0	67.0	67.0	68.0	68.0	68.0	67.0	67.0	67.0	66.0	68.0	68.0	69.0	69.0	67.0	67.0	67.0	67.0	66.0	67.0	67.0	63.0
5:30 AM	44.0	67.0	67.0	67.0	66.0	66.0	66.0	66.0	67.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	67.0	67.0	67.0	66.0	69.0	68.0	70.0	70.0	69.0	69.0	69.0	69.0	68.0	69.0	67.0	62.0
5:45 AM	46.0	63.0	66.0	67.0	66.0	67.0	66.0	66.0	67.0	67.0	67.0	68.0	68.0	68.0	68.0	68.0	69.0	69.0	69.0	68.0	67.0	68.0	66.0	67.0	68.0	68.0	68.0	68.0	68.0	68.0	67.0	68.0	67.0	68.0	61.0
6:00 AM	47.0	64.0	67.0	67.0	68.0	68.0	68.0	69.0	69.0	69.0	68.0	68.0	68.0	70.0	69.0	69.0	70.0	69.0	69.0	68.0	67.0	68.0	68.0	68.0	69.0	70.0	70.0	69.0	69.0	69.0	69.0	69.0	69.0	70.0	57.0
6:15 AM	47.0	66.0	67.0	66.0	66.0	67.0	68.0	69.0	69.0	67.0	69.0	68.0	69.0	70.0	69.0	69.0	70.0	70.0	70.0	68.0	68.0	69.0	69.0	68.0	68.0	71.0	70.0	69.0	69.0	69.0	69.0	69.0	70.0	70.0	61.0
6:30 AM	47.0	63.0	65.0	67.0	66.0	67.0	68.0	68.0	67.0	67.0	68.0	68.0	68.0	69.0	69.0	68.0	69.0	69.0	69.0	68.0	68.0	69.0	69.0	68.0	69.0	69.0	70.0	69.0	69.0	69.0	68.0	69.0	69.0	69.0	59.0
6:45 AM	49.0	64.0	66.0	67.0	68.0	67.0	67.0	67.0	68.0	68.0	69.0	67.0	69.0	67.0	68.0	67.0	70.0	70.0	70.0	67.0	66.0	67.0	66.0	67.0	67.0	68.0	68.0	68.0	68.0	67.0	67.0	66.0	67.0	67.0	57.0
7:00 AM	48.0	64.0	65.0	65.0	65.0	65.0	66.0	66.0	66.0	67.0	67.0	67.0	67.0	68.0	67.0	69.0	70.0	69.0	68.0	67.0	66.0	65.0	63.0	65.0	66.0	68.0	68.0	69.0	67.0	66.0	67.0	67.0	68.0	69.0	58.0
7:15 AM	49.0	63.0	64.0	65.0	65.0	64.0	65.0	66.0	65.0	65.0	66.0	66.0	66.0	66.0	66.0	66.0	67.0	68.0	66.0	64.0	64.0	63.0	62.0	62.0	62.0	65.0	66.0	64.0	64.0	64.0	65.0	65.0	67.0	67.0	57.0
7:30 AM	51.0	62.0	63.0	63.0	62.0	62.0	63.0	65.0	64.0	65.0	67.0	66.0	66.0	68.0	66.0	68.0	70.0	68.0	64.0	59.0	58.0	56.0	53.0	55.0	55.0	62.0	64.0	65.0	63.0	63.0	65.0	65.0	68.0	67.0	57.0
7:45 AM	47.0	61.0	61.0	61.0	54.0	57.0	60.0	63.0	63.0	64.0	66.0	65.0	66.0	66.0	65.0	66.0	66.0	62.0	52.0	39.0	40.0	37.0	37.0	40.0	47.0	58.0	61.0	64.0	61.0	61.0	63.0	63.0	65.0	66.0	57.0
8:00 AM	47.0	59.0	56.0	52.0	47.0	52.0	59.0	62.0	63.0	63.0	65.0	64.0	66.0	66.0	65.0	66.0	66.0	63.0	50.0	46.0	43.0	41.0	38.0	38.0	44.0	56.0	59.0	61.0	59.0	60.0	62.0	63.0	65.0	65.0	57.0
8:15 AM	48.0	60.0	61.0	60.0	57.0	58.0	61.0	62.0	63.0	63.0	66.0	64.0	66.0	67.0	65.0	66.0	65.0	62.0	50.0	44.0	43.0	40.0	38.0	39.0	44.0	55.0	57.0	61.0	58.0	57.0	61.0	61.0	65.0	65.0	53.0
8:30 AM	46.0	59.0	59.0	54.0	52.0	55.0	59.0	63.0	63.0	64.0	66.0	65.0	67.0	68.0	66.0	66.0	67.0	64.0	49.0	40.0	36.0	35.0	34.0	37.0	44.0	55.0	57.0	58.0	58.0	57.0	62.0	61.0	65.0	65.0	53.0
8:45 AM	46.0	62.0	62.0	60.0	57.0	59.0	60.0	62.0	62.0	64.0	65.0	64.0	65.0	65.0	65.0	65.0	65.0	62.0	40.0	35.0	35.0	34.0	34.0	36.0	41.0	51.0	57.0	61.0	60.0	59.0	62.0	61.0	65.0	66.0	56.0
9:00 AM	46.0	62.0	63.0	62.0	62.0	63.0	63.0	64.0	64.0	65.0	66.0	65.0	66.0	67.0	66.0	67.0	66.0	64.0	57.0	54.0	54.0	50.0	49.0	52.0	52.0	57.0	60.0	62.0	62.0	62.0	62.0	61.0	64.0	64.0	53.0
9:15 AM	47.0	63.0	65.0	65.0	65.0	65.0	65.0	67.0	65.0	67.0	66.0	67.0	68.0	67.0	68.0	67.0	69.0	68.0	66.0	64.0	65.0	65.0	64.0	64.0	65.0	66.0	65.0	65.0	64.0	65.0	63.0	63.0	65.0	65.0	52.0
9:30 AM	47.0	64.0	65.0	65.0	65.0	65.0	66.0	66.0	68.0	67.0	67.0	68.0	67.0	68.0	67.0	68.0	70.0	70.0	68.0	65.0	66.0	66.0	67.0	67.0	67.0	68.0	69.0	69.0	67.0	67.0	66.0	65.0	67.0	67.0	52.0
9:45 AM	46.0	63.0	65.0	65.0	67.0	65.0	66.0	67.0	69.0	68.0	69.0	68.0	67.0	69.0	70.0	69.0	71.0	69.0	68.0	66.0	66.0	67.0	66.0	67.0	67.0	68.0	67.0	67.0	66.0	66.0	66.0	66.0	68.0	68.0	52.0
10:00 AM	47.0	65.0	66.0	68.0	67.0	67.0	67.0	68.0	67.0	68.0	68.0	67.0	68.0	69.0	68.0	69.0	70.0	69.0	68.0	66.0	66.0	67.0	66.0	67.0	67.0	68.0	69.0	69.0	67.0	67.0	67.0	66.0	68.0	68.0	52.0
10:15 AM	48.0	64.0	66.0	67.0	67.0	66.0	67.0	68.0	68.0	67.0	68.0	66.0	68.0	69.0	68.0	69.0	69.0	69.0	68.0	65.0	66.0	67.0	67.0	68.0	68.0	69.0	69.0	68.0	68.0	67.0	66.0	67.0	68.0	67.0	52.0
10:30 AM	48.0	64.0	66.0	66.0	66.0	67.0	66.0	68.0	68.0	69.0	69.0	67.0	68.0	69.0	68.0	69.0	69.0	69.0	68.0	67.0	67.0	68.0	66.0	67.0	68.0	69.0	69.0	69.0	67.0	67.0	65.0	67.0	68.0	68.0	53.0
10:45 AM	49.0	64.0	67.0	68.0	67.0	67.0	67.0	69.0	66.0	67.0	69.0	67.0	68.0	68.0	68.0	69.0	70.0	69.0	69.0	67.0	67.0	69.0	67.0	67.0	68.0	69.0	69.0	69.0	67.0	68.0	66.0	67.0	68.0	68.0	53.0
11:00 AM	49.0	64.0	66.0	67.0	67.0	67.0	67.0	68.0	68.0	68.0	68.0	67.0	70.0	70.0	68.0	69.0	71.0	70.0	69.0	66.0	67.0	68.0	67.0	68.0	67.0	69.0	69.0	69.0	68.0	67.0	65.0	66.0	67.0	68.0	51.0
11:15 AM	50.0	66.0	67.0	67.0	67.0	68.0	68.0	69.0	68.0	68.0	71.0	69.0	70.0	70.0	69.0	69.0	69.0	69.0	69.0	66.0	68.0	68.0	67.0	68.0	68.0	69.0	69.0	69.0	68.0	67.0	66.0	67.0	69.0	67.0	52.0
11:30 AM	49.0	64.0	67.0	68.0	69.0	68.0	68.0	70.0	69.0	69.0	70.0	68.0	70.0	70.0	68.0	69.0	70.0	69.0	68.0	68.0	67.0	68.0	67.0	68.0	68.0	69.0	69.0	69.0	68.0	67.0	67.0	67.0	68.0	69.0	54.0
11:45 AM	49.0	64.0	66.0	67.0	68.0	67.0	68.0	69.0	68.0	68.0	69.0	67.0	68.0	69.0	68.0	69.0	70.0	70.0	69.0	66.0	67.0	67.0	67.0	68.0	68.0	69.0	68.0	68.0	67.0	67.0	66.0	67.0	67.0	67.0	55.0
12:00 PM	49.0	65.0	67.0	67.0	67.0	68.0	68.0	69.0	68.0	68.0	69.0	67.0	68.0	68.0	67.0	69.0	69.0	69.0	68.0	65.0	66.0	68.0	67.0	67.0	67.0	68.0	69.0	68.0	68.0	67.0	66.0	66.0	67.0	69.0	58.0
12:15 PM	50.0	65.0	67.0	67.0	67.0	67.0	66.0	68.0	68.0	68.0	69.0	67.0	69.0	70.0	68.0	69.0	70.0	69.0	68.0	66.0	67.0	69.0	67.0	68.0	68.0	70.0	69.0	69.0	69.0	67.0	67.0	68.0	69.0	67.0	56.0
12:30 PM	50.0	64.0	67.0	66.0	66.0	67.0	68.0	68.0	69.0	68.0	69.0	68.0	69.0	68.0	69.0	70.0	70.0	69.0	69.0	67.0	68.0	68.0	67.0	68.0	68.0	69.0	69.0	68.0	67.0	68.0	67.0	68.0	66.0	67.0	57.0
12:45 PM	49.0	65.0	67.0	67.0	68.0	68.0	67.0	69.0	67.0	67.0	69.0	67.0	69.0	68.0	69.0	69.0	69.0	69.0	68.0	67.0	68.0	68.0	67.0	67.0	67.0	69.0	69.0	69.0	67.0	67.0	66.0	67.0	68.0	67.0	58.0
1:00 PM	49.0	65.0	66.0	67.0	67.0	68.0	68.0	69.0	68.0	68.0	69.0	67.0	68.0	69.0	68.0	69.0	70.0	70.0	70.0	67.0	67.0	67.0	68.0	67.0	68.0	68.0	69.0	68.0	69.0	67.0	67.0	66.0	68.0	67.0	55.0
1:15 PM	49.0	64.0	67.0	67.0	68.0	68.0	68.0	69.0	68.0	68.0	69.0	68.0	67.0	68.0	69.0	67.0	69.0	70.0	69.0	69.0	67.0	67.0	67.0	67.0	67.0	68.0	70.0	69.0	68.0	67.0	67.0	67.0	68.0	67.0	56.0
1:30 PM	49.0	65.0	67.0	66.0	66.0	67.0	67.0	67.0	68.0	68.0	67.0	68.0	67.0	68.0	69.0	68.0	69.0	70.0	69.0	68.0	66.0	66.0	67.0	66.0	68.0	68.0	70.0	68.0	69.0	67.0	66.0	67.0	68.0	67.0	52.0
1:45 PM	50.0	65.0	66.0	67.0	67.0	67.0	67.0	68.0	68.0	69.0	68.0	66.0	68.0	69.0	68.0	69.0	69.0	69.0	68.0	66.0	67.0	68.0	67.0	67.0	68.0	69.0	70.0	70.0	68.0	67.0	66.0	67.0	68.0	67.0	58.0
2:00 PM	50.0	65.0	67.0	67.0	68.0	68.0	68.0	69.0	68.0	68.0	70.0	68.0	69.0	70.0	69.0	70.0	70.0	69.0	69.0	67.0	67.0	68.0	67.0	68.0	68.0	69.0	68.0	68.0	67.0	67.0	66.0	67.0	68.0	67.0	58.0
2:15 PM	51.0	64.0	66.0	67.0	67.0	68.0	67.0	68.0	68.0	67.0	68.0	68.0	67.0	68.0	69.0	69.0	69.0	69.0	69.0	68.0	66.0	66.0	67.0	66.0	68.0	67.0	69.0	68.0	67.0	68.0	67.0	67.0	68.0	67.0	57.0
2:30 PM	50.0	64.0	66.0	67.0	66.0	68.0	67.0	68.0	68.0	68.0	68.0	67.0	68.0	69.0	67.0	69.0	70.0	70.0	69.0	66.0	66.0	67.0	66.0	67.0	67.0	68.0	68.0	68.0	66.0	66.0	65.0	66.0	66.0	67.0	57.0
2:45 PM	51.0	63.0	66.0	66.0	67.0	67.0	67.0	68.0	68.0	68.0	69.0	67.0	68.0	68.0	67.0	68.0	69.0	69.0	68.0	67.0	66.0	66.0	66.0	66.0	66.0	67.0	66.0	65.0	64.0	64.0	63.0	63.0	65.0	65.0	56.0
3:00 PM	51.0	64.0	66.0	67.0	67.0	67.0	67.0	69.0	68.0	69.0	69.0	67.0	68.0	67.0	68.0	69.0	69.0	69.0	68.0	65.0	66.0	65.0	64.0	64.0	65.0	66.0	65.0	64.0	63.0	61.0	55.0	55.0	61.0	62.0	54.0
3:15 PM	51.0	64.0	65.0	67.0	68.0	66.0	66.0	67.0	68.0	68.0	68.0	67.0	67.0	67.0	67.0	68.0	68.0	65.0	61.0	58.0	54.0	51.0	49.0	50.0	52.0	58.0	59.0	55.0	49.0	52.0	57.0	56.0	57.0	50.0	48.0
3:30 PM	51.0	64.0	65.0	66.0	67.0	67.0	67.0	69.0	68.0	68.0	68.0	67.0	67.0	67.0	66.0	66.0	65.0	58.0	42.0	36.0	38.0	33.0	32.0	33.0	41.0	56.0	58.0	55.0	49.0	51.0	47.0	46.0	37.0	32.0	47.0
3:45 PM	52.0	64.0	65.0	67.0	67.0	67.0	67.0	69.0	68.0	67.0	68.0	68.0	67.0	67.0	65.0	65.0	58.0	40.0	30.0	29.0	30.0	30.0	29.0	31.0	36.0	47.0	49.0	43.0	37.0	38.0	37.0	39.0	29.0	25.0	42.0
4:00 PM	51.0	64.0	66.0	67.0	68.0	67.0	67.0	68.0	68.0	69.0	69.0	68.0	66.0	64.0	63.0	64.0	56.0	37.0	31.0	30.0	30.0	28.0	30.0	30.0	34.0	44.0	46.0	41.0	34.0	31.0	32.0	36.0	28.0	22.0	38.0
4:15 PM	50.0	63.0	64.0	66.0	67.0	66.0	66.0	68.0	67.0	68.0	68.0	67.0	66.0	65.0	61.0	60.0	40.0	29.0	26.0	27.0	29.0	26.0	26.0	29.0	31.0	37.0	35.0	35.0	30.0	28.0	29.0	30.0	25.0	18.0	37.0
4:30 PM	51.0	64.0	65.0	67.0	68.0	67.0	66.0	68.0	67.0	68.0	68.0	67.0	66.0	64.0	61.0	58.0	41.0	29.0	24.0	24.0	23.0	22.0	24.0	24.0	28.0	31.0	31.0	31.0	26.0	28.0	28.0	26.0	21.0	17.0	38.0
4:45 PM	51.0	63.0	65.0	67.0	68.0	67.0	67.0	68.0	68.0	68.0	69.0	68.0	66.0	63.0	60.0	56.0	33.0	22.0	21.0	22.0	21.0	22.0	22.0	23.0	25.0	29.0	29.0	27.0	27.0	26.0	27.0	28.0	23.0	17.0	38.0
5:00 PM	50.0	62.0	65.0	66.0	68.0	67.0	66.0	68.0	68.0	68.0	68.0	67.0	67.0	64.0	62.0	56.0	32.0	18.0	17.0	17.0	18.0	19.0	20.0	21.0	24.0	29.0	29.0	28.0	24.0	25.0	25.0	25.0	22.0	15.0	34.0
5:15 PM	49.0	61.0	63.0	65.0	66.0	65.0	65.0	67.0	66.0	66.0	67.0	66.0	64.0	60.0	52.0	34.0	22.0	21.0	18.0	17.0	18.0	17.0	20.0	19.0	21.0	24.0	25.0	25.0	24.0	24.0	26.0	25.0	22.0	18.0	37.0
5:30 PM	49.0	59.0	62.0	63.0	65.0	64.0	64.0	65.0	64.0	66.0	65.0	65.0	64.0	60.0	51.0	26.0	17.0	15.0	14.0	16.0	16.0	16.0	17.0	18.0	21.0	25.0	25.0	23.0	22.0	23.0	25.0	25.0	23.0	19.0	35.0
5:45 PM	48.0	60.0	61.0	63.0	65.0	63.0	64.0	66.0	65.0	65.0	66.0	65.0	62.0	53.0	38.0	37.0	20.0	21.0	17.0	17.0	18.0	19.0	19.0	20.0	23.0	24.0	25.0	25.0	24.0	24.0	25.0	25.0	21.0	20.0	36.0
6:00 PM	48.0	61.0	63.0	64.0	65.0	65.0	65.0	67.0	66.0	66.0	66.0	66.0	64.0	58.0	50.0	47.0	29.0	17.0	23.0	19.0	20.0	19.0	19.0	20.0	23.0	24.0	27.0	25.0	23.0	25.0	26.0	27.0	24.0	22.0	38.0
6:15 PM	48.0	60.0	63.0	64.0	65.0	65.0	65.0	67.0	67.0	66.0	66.0	65.0	66.0	65.0	62.0	60.0	41.0	26.0	24.0	21.0	22.0	25.0	24.0	25.0	25.0	28.0	28.0	27.0	25.0	25.0	26.0	28.0	25.0	20.0	40.0
6:30 PM	50.0	62.0	64.0	65.0	66.0	65.0	66.0	67.0	66.0	66.0	67.0	66.0	66.0	66.0	65.0	65.0	62.0	49.0	37.0	32.0	27.0	27.0	25.0	28.0	30.0	32.0	35.0	32.0	29.0	30.0	30.0	31.0	27.0	22.0	41.0
6:45 PM	50.0	61.0	63.0	65.0	67.0	66.0	67.0	68.0	68.0	67.0	68.0	67.0	68.0	69.0	68.0	68.0	68.0	67.0	56.0	61.0	57.0	46.0	39.0	37.0	35.0	42.0	47.0	43.0	35.0	35.0	36.0	42.0	34.0	31.0	44.0
7:00 PM	49.0	62.0	65.0	66.0	66.0	66.0	68.0	69.0	68.0	68.0	68.0	67.0	69.0	70.0	69.0	70.0	70.0	70.0	68.0	66.0	64.0	64.0	61.0	64.0	64.0	63.0	62.0	60.0	60.0	59.0	58.0	58.0	57.0	52.0	47.0
7:15 PM	49.0	61.0	65.0	66.0	66.0	67.0	67.0	68.0	68.0	69.0	68.0	67.0	69.0	70.0	70.0	70.0	70.0	70.0	70.0	66.0	67.0	68.0	66.0	68.0	68.0	68.0	67.0	66.0	66.0	66.0	66.0	64.0	67.0	65.0	49.0
7:30 PM	50.0	64.0	66.0	67.0	68.0	68.0	69.0	68.0	67.0	68.0	69.0	67.0	69.0	69.0	69.0	69.0	70.0	71.0	69.0	67.0	67.0	68.0	66.0	68.0	68.0	69.0	68.0	68.0	66.0	67.0	66.0	65.0	67.0	66.0	52.0
7:45 PM	50.0	64.0	67.0	68.0	69.0	69.0	69.0	70.0	68.0	70.0	70.0	68.0	69.0	70.0	69.0	71.0	70.0	71.0	70.0	68.0	67.0	68.0	67.0	69.0	68.0	69.0	69.0	67.0	68.0	67.0	68.0	68.0	69.0	67.0	56.0
8:00 PM	49.0	64.0	66.0	67.0	68.0	69.0	69.0	70.0	69.0	69.0	71.0	70.0	71.0	72.0	70.0	70.0	71.0	69.0	68.0	66.0	67.0	68.0	67.0	67.0	67.0	69.0	68.0	68.0	67.0	68.0	67.0	68.0	68.0	67.0	58.0
8:15 PM	49.0	64.0	66.0	66.0	67.0	68.0	68.0	68.0	68.0	68.0	69.0	69.0	70.0	70.0	68.0	69.0	70.0	71.0	69.0	68.0	68.0	69.0	67.0	68.0	68.0	70.0	69.0	69.0	68.0	68.0	68.0	66.0	67.0	68.0	59.0
8:30 PM	50.0	65.0	68.0	68.0	68.0	69.0	69.0	68.0	68.0	69.0	69.0	67.0	69.0	69.0	68.0	70.0	71.0	70.0	70.0	69.0	68.0	69.0	67.0	69.0	69.0	69.0	69.0	69.0	68.0	68.0	69.0	66.0	70.0	69.0	58.0
8:45 PM	49.0	65.0	66.0	66.0	67.0	68.0	68.0	68.0	68.0	69.0	69.0	69.0	69.0	69.0	68.0	69.0	70.0	70.0	70.0	69.0	69.0	70.0	68.0	68.0	68.0	69.0	69.0	69.0	69.0	69.0	69.0	68.0	69.0	69.0	58.0
9:00 PM	50.0	65.0	67.0	66.0	68.0	69.0	70.0	68.0	69.0	69.0	68.0	68.0	67.0	68.0	66.0	68.0	68.0	67.0	66.0	67.0	67.0	68.0	66.0	68.0	68.0	69.0	70.0	69.0	68.0	67.0	68.0	66.0	69.0	68.0	60.0
9:15 PM	49.0	66.0	67.0	68.0	68.0	68.0	68.0	68.0	67.0	67.0	67.0	67.0	68.0	68.0	68.0	68.0	69.0	69.0	69.0	68.0	68.0	68.0	66.0	68.0	68.0	69.0	69.0	69.0	67.0	67.0	68.0	67.0	68.0	68.0	60.0
9:30 PM	50.0	67.0	68.0	66.0	68.0	66.0	66.0	67.0	68.0	68.0	68.0	69.0	67.0	67.0	68.0	67.0	67.0	68.0	67.0	68.0	68.0	69.0	68.0	68.0	69.0	70.0	68.0	69.0	68.0	67.0	67.0	65.0	68.0	69.0	61.0
9:45 PM	49.0	67.0	68.0	66.0	67.0	69.0	69.0	67.0	67.0	69.0	68.0	68.0	68.0	67.0	68.0	68.0	68.0	68.0	67.0	68.0	67.0	68.0	68.0	67.0	68.0	68.0	69.0	68.0	68.0	67.0	66.0	67.0	69.0	69.0	61.0
10:00 PM	53.0	65.0	66.0	66.0	66.0	67.0	67.0	67.0	67.0	67.0	68.0	67.0	68.0	68.0	67.0	67.0	68.0	67.0	67.0	67.0	68.0	68.0	67.0	68.0	68.0	68.0	68.0	69.0	68.0	67.0	67.0	66.0	68.0	69.0	55.0
10:15 PM	53.0	67.0	67.0	67.0	67.0	68.0	68.0	66.0	67.0	68.0	68.0	67.0	69.0	67.0	67.0	68.0	70.0	69.0	68.0	67.0	67.0	68.0	66.0	67.0	68.0	68.0	68.0	68.0	67.0	67.0	67.0	65.0	68.0	68.0	55.0
10:30 PM	53.0	67.0	69.0	67.0	67.0	67.0	68.0	67.0	67.0	68.0	67.0	68.0	68.0	68.0	67.0	68.0	68.0	68.0	68.0	68.0	67.0	68.0	66.0	67.0	67.0	68.0	68.0	68.0	68.0	67.0	67.0	66.0	68.0	69.0	55.0
10:45 PM	53.0	67.0	69.0	68.0	67.0	68.0	67.0	68.0	67.0	68.0	68.0	67.0	68.0	68.0	67.0	68.0	68.0	68.0	68.0	68.0	67.0	68.0	66.0	67.0	67.0	68.0	68.0	67.0	68.0	68.0	67.0	66.0	68.0	69.0	55.0
11:00 PM	53.0	67.0	68.0	66.0	67.0	67.0	67.0	67.0	67.0	67.0	68.0	67.0	67.0	67.0	67.0	68.0	67.0	67.0	67.0	67.0	67.0	67.0	67.0	67.0	67.0	68.0	68.0	68.0	67.0	67.0	68.0	66.0	68.0	69.0	55.0
11:15 PM	53.0	67.0	68.0	67.0	67.0	68.0	67.0	68.0	68.0	68.0	69.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	69.0	68.0	68.0	68.0	67.0	68.0	68.0	69.0	69.0	68.0	68.0	67.0	67.0	69.0	68.0	55.0
11:30 PM	53.0	66.0	68.0	66.0	67.0	67.0	66.0	66.0	67.0	68.0	67.0	67.0	68.0	67.0	68.0	67.0	68.0	68.0	68.0	68.0	67.0	67.0	67.0	67.0	67.0	68.0	68.0	68.0	68.0	67.0	66.0	67.0	69.0	69.0	55.0
11:45 PM	53.0	66.0	67.0	67.0	67.0	67.0	67.0	66.0	67.0	67.0	67.0	66.0	67.0	67.0	67.0	66.0	67.0	67.0	67.0	68.0	67.0	67.0	67.0	66.0	67.0	68.0	68.0	68.0	68.0	67.0	68.0	66.0	68.0	69.0	55.0

Green	Greater than 55 mph
Yellow	45 to 55 mph
Orange	35 to 45 mph
Red	Less than 35 mph

Figure 38: Speed Contours, I-680 Study Corridor Northbound, Supplemental Before Study (2017)

I-680 Northbound 50th Percentile Speeds Immediately Before Study (2017)

Target Time	I-580 Off-Ramp to I-580 On-Ramp	I-580 On-Ramp to Village Pkwy On-Ramp	Village Pkwy On-Ramp to West of Canterbury Ln	West of Canterbury Ln to Alcosta Blvd Off-Ramp	Alcosta Blvd Off-Ramp to Alcosta Blvd On-Ramp	Alcosta Blvd On-Ramp to West of Winthrop Ave	West of Winthrop Ave to West of Pine Valley Rd	West of Pine Valley Rd to West of Waterbury Way	West of Waterbury Way to West of Soccer Fields	West of Soccer Fields to Bollinger Canyon Rd Off-Ramp	Bollinger Canyon Rd Off-Ramp to Bollinger Canyon Rd Loop On-Ramp	Bollinger Canyon Rd Loop On-Ramp to Bollinger Canyon Rd Diag. On-Ramp	Bollinger Canyon Rd Diag. On-Ramp to Crow Canyon Rd Off-Ramp	Crow Canyon Rd Off-Ramp to Crow Canyon Rd Loop On-Ramp	Crow Canyon Rd Loop On-Ramp to Crow Canyon Rd Diag On-Ramp	Crow Canyon Rd Diag On-Ramp to West of Mission Pl	West of Mission Pl to West of Delta Way	West of Delta Way to Sycamore Valley Rd Off-Ramp
12:00 AM	53.0	60.0	63.0	63.0	63.0	62.0	63.0	63.0	63.0	63.0	63.0	62.0	63.0	63.0	64.0	64.0	65.0	64.0
12:15 AM	53.0	58.0	60.0	61.0	62.0	61.0	62.0	64.0	64.0	63.0	62.0	62.0	62.0	62.0	62.0	62.0	64.0	64.0
12:30 AM	54.0	58.0	61.0	61.0	61.0	62.0	62.0	62.0	62.0	62.0	62.0	61.0	62.0	62.0	62.0	63.0	63.0	62.0
12:45 AM	52.0	59.0	60.0	61.0	61.0	62.0	62.0	63.0	63.0	63.0	63.0	62.0	63.0	63.0	63.0	63.0	64.0	64.0
1:00 AM	51.0	58.0	60.0	61.0	61.0	61.0	61.0	62.0	61.0	61.0	62.0	61.0	62.0	62.0	62.0	63.0	62.0	63.0
1:15 AM	51.0	58.0	59.0	61.0	60.0	61.0	62.0	61.0	61.0	61.0	62.0	61.0	62.0	63.0	62.0	62.0	62.0	62.0
1:30 AM	52.0	58.0	60.0	61.0	62.0	62.0	63.0	63.0	63.0	63.0	63.0	62.0	63.0	64.0	63.0	64.0	63.0	64.0
1:45 AM	51.0	58.0	60.0	61.0	61.0	62.0	62.0	63.0	62.0	62.0	62.0	61.0	62.0	62.0	61.0	62.0	63.0	63.0
2:00 AM	52.0	58.0	62.0	61.0	61.0	62.0	62.0	63.0	62.0	63.0	62.0	62.0	62.0	62.0	62.0	64.0	63.0	63.0
2:15 AM	52.0	59.0	61.0	61.0	61.0	62.0	62.0	62.0	61.0	62.0	61.0	61.0	61.0	62.0	61.0	62.0	63.0	63.0
2:30 AM	53.0	59.0	62.0	62.0	63.0	64.0	63.0	63.0	63.0	63.0	63.0	62.0	63.0	63.0	63.0	64.0	63.0	64.0
2:45 AM	52.0	58.0	60.0	61.0	63.0	63.0	62.0	63.0	62.0	62.0	62.0	62.0	62.0	63.0	62.0	63.0	63.0	64.0
3:00 AM	52.0	59.0	61.0	62.0	62.0	63.0	63.0	62.0	61.0	61.0	62.0	61.0	62.0	62.0	62.0	62.0	62.0	63.0
3:15 AM	52.0	57.0	61.0	61.0	62.0	63.0	63.0	63.0	63.0	63.0	63.0	62.0	62.0	62.0	62.0	63.0	62.0	62.0
3:30 AM	51.0	57.0	59.0	60.0	61.0	61.0	61.0	62.0	61.0	61.0	61.0	61.0	61.0	62.0	61.0	62.0	62.0	62.0
3:45 AM	50.0	59.0	61.0	62.0	63.0	64.0	63.0	64.0	64.0	64.0	64.0	63.0	64.0	63.0	63.0	64.0	64.0	65.0
4:00 AM	50.0	58.0	60.0	62.0	62.0	62.0	62.0	63.0	62.0	63.0	62.0	62.0	63.0	63.0	62.0	63.0	64.0	63.0
4:15 AM	50.0	59.0	61.0	62.0	63.0	63.0	62.0	63.0	63.0	63.0	63.0	62.0	63.0	64.0	66.0	66.0	65.0	65.0
4:30 AM	50.0	58.0	61.0	62.0	63.0	63.0	63.0	63.0	63.0	62.0	62.0	63.0	64.0	65.0	64.0	65.0	65.0	65.0
4:45 AM	49.0	58.0	61.0	63.0	63.0	63.0	63.0	64.0	63.0	63.0	63.0	62.0	63.0	63.0	64.0	64.0	64.0	65.0
5:00 AM	49.0	60.0	65.0	65.0	66.0	66.0	66.0	66.0	65.0	65.0	64.0	64.0	65.0	66.0	66.0	67.0	69.0	68.0
5:15 AM	48.0	59.0	61.0	61.0	62.0	63.0	64.0	64.0	62.0	62.0	63.0	64.0	65.0	65.0	64.0	65.0	66.0	67.0
5:30 AM	47.0	60.0	62.0	63.0	64.0	64.0	64.0	65.0	63.0	63.0	63.0	63.0	64.0	65.0	65.0	67.0	67.0	66.0
5:45 AM	48.0	62.0	64.0	64.0	65.0	65.0	65.0	66.0	65.0	64.0	64.0	64.0	64.0	65.0	64.0	66.0	67.0	67.0
6:00 AM	51.0	62.0	65.0	65.0	66.0	66.0	66.0	66.0	66.0	65.0	65.0	64.0	65.0	67.0	64.0	66.0	68.0	68.0
6:15 AM	51.0	65.0	64.0	65.0	65.0	65.0	65.0	66.0	65.0	65.0	64.0	64.0	65.0	65.0	63.0	66.0	66.0	66.0
6:30 AM	50.0	64.0	65.0	67.0	65.0	65.0	66.0	69.0	67.0	67.0	69.0	67.0	69.0	69.0	66.0	69.0	70.0	69.0
6:45 AM	51.0	64.0	65.0	64.0	65.0	65.0	65.0	67.0	65.0	66.0	67.0	66.0	68.0	70.0	67.0	70.0	72.0	71.0
7:00 AM	52.0	63.0	64.0	66.0	67.0	65.0	67.0	69.0	70.0	68.0	70.0	69.0	70.0	70.0	68.0	69.0	70.0	70.0
7:15 AM	50.0	61.0	63.0	62.0	62.0	61.0	63.0	65.0	66.0	66.0	69.0	67.0	67.0	68.0	68.0	69.0	72.0	73.0
7:30 AM	48.0	45.0	37.0	45.0	45.0	53.0	60.0	64.0	64.0	65.0	66.0	67.0	68.0	69.0	67.0	68.0	69.0	70.0
7:45 AM	41.0	19.0	23.0	32.0	44.0	49.0	57.0	63.0	64.0	66.0	68.0	67.0	68.0	69.0	67.0	69.0	70.0	65.0
8:00 AM	37.0	19.0	20.0	27.0	31.0	39.0	54.0	63.0	63.0	64.0	67.0	66.0	67.0	68.0	67.0	67.0	64.0	61.0
8:15 AM	41.0	17.0	20.0	27.0	33.0	41.0	54.0	62.0	63.0	63.0	65.0	65.0	68.0	67.0	65.0	65.0	59.0	33.0
8:30 AM	42.0	20.0	21.0	30.0	34.0	40.0	54.0	61.0	62.0	62.0	67.0	64.0	66.0	66.0	63.0	63.0	47.0	36.0
8:45 AM	43.0	21.0	21.0	28.0	32.0	39.0	53.0	61.0	62.0	62.0	66.0	66.0	66.0	68.0	64.0	65.0	54.0	38.0
9:00 AM	47.0	37.0	36.0	44.0	53.0	55.0	59.0	63.0	62.0	62.0	64.0	64.0	66.0	68.0	66.0	68.0	66.0	58.0
9:15 AM	51.0	63.0	64.0	64.0	64.0	64.0	64.0	65.0	64.0	64.0	67.0	67.0	67.0	68.0	67.0	69.0	68.0	68.0
9:30 AM	50.0	65.0	66.0	66.0	67.0	67.0	69.0	69.0	68.0	69.0	71.0	69.0	70.0	71.0	70.0	70.0	70.0	70.0
9:45 AM	50.0	63.0	65.0	66.0	66.0	66.0	67.0	68.0	67.0	68.0	68.0	68.0	67.0	68.0	66.0	68.0	69.0	70.0
10:00 AM	50.0	66.0	67.0	67.0	67.0	67.0	66.0	68.0	68.0	67.0	67.0	69.0	68.0	66.0	67.0	68.0	68.0	68.0
10:15 AM	50.0	64.0	66.0	66.0	67.0	67.0	67.0	68.0	68.0	71.0	69.0	67.0	68.0	68.0	68.0	69.0	70.0	70.0
10:30 AM	49.0	66.0	68.0	69.0	71.0	70.0	69.0	71.0	71.0	71.0	70.0	69.0	71.0	69.0	71.0	71.0	70.0	72.0
10:45 AM	51.0	65.0	67.0	67.0	67.0	67.0	66.0	69.0	69.0	69.0	70.0	68.0	70.0	69.0	70.0	71.0	72.0	72.0
11:00 AM	51.0	65.0	67.0	67.0	66.0	66.0	66.0	69.0	68.0	68.0	68.0	68.0	68.0	68.0	69.0	70.0	70.0	69.0
11:15 AM	52.0	64.0	66.0	66.0	66.0	66.0	67.0	68.0	67.0	67.0	68.0	67.0	68.0	67.0	66.0	68.0	69.0	70.0
11:30 AM	52.0	65.0	67.0	67.0	68.0	67.0	67.0	69.0	68.0	67.0	68.0	68.0	69.0	69.0	69.0	70.0	70.0	71.0
11:45 AM	52.0	66.0	67.0	68.0	69.0	69.0	70.0	70.0	70.0	69.0	68.0	68.0	69.0	70.0	69.0	69.0	70.0	71.0
12:00 PM	52.0	65.0	66.0	68.0	68.0	69.0	69.0	70.0	70.0	70.0	71.0	72.0	72.0	70.0	70.0	70.0	71.0	70.0
12:15 PM	54.0	65.0	69.0	67.0	65.0	66.0	66.0	67.0	67.0	68.0	68.0	68.0	69.0	70.0	69.0	69.0	69.0	69.0
12:30 PM	52.0	66.0	67.0	67.0	68.0	67.0	69.0	70.0	68.0	68.0	71.0	70.0	70.0	72.0	69.0	69.0	70.0	71.0
12:45 PM	53.0	64.0	67.0	68.0	69.0	69.0	70.0	70.0	70.0	71.0	72.0	70.0	70.0	71.0	70.0	71.0	71.0	71.0
1:00 PM	53.0	65.0	67.0	66.0	66.0	67.0	69.0	68.0	69.0	68.0	67.0	67.0	68.0	69.0	69.0	69.0	69.0	70.0
1:15 PM	53.0	66.0	68.0	68.0	68.0	68.0	68.0	70.0	69.0	69.0	70.0	70.0	71.0	71.0	71.0	71.0	71.0	71.0
1:30 PM	52.0	65.0	67.0	67.0	67.0	67.0	67.0	68.0	68.0	69.0	68.0	69.0	70.0	69.0	68.0	69.0	69.0	70.0
1:45 PM	54.0	66.0	67.0	67.0	68.0	69.0	69.0	70.0	69.0	69.0	71.0	71.0	71.0	71.0	69.0	71.0	71.0	71.0
2:00 PM	53.0	66.0	68.0	67.0	68.0	69.0	69.0	70.0	68.0	69.0	70.0	70.0	71.0	71.0	70.0	71.0	72.0	73.0
2:15 PM	52.0	64.0	65.0	66.0	67.0	67.0	68.0	70.0	69.0	70.0	69.0	69.0	70.0	71.0	69.0	70.0	71.0	71.0
2:30 PM	53.0	64.0	66.0	67.0	69.0	68.0	70.0	71.0	70.0	71.0	70.0	69.0	69.0	70.0	68.0	70.0	72.0	71.0
2:45 PM	52.0	67.0	67.0	67.0	69.0	69.0	68.0	70.0	70.0	70.0	70.0	70.0	69.0	70.0	69.0	70.0	71.0	70.0
3:00 PM	52.0	65.0	68.0	67.0	68.0	69.0	68.0	70.0	70.0	71.0	70.0	70.0	71.0	71.0	71.0	70.0	71.0	71.0
3:15 PM	51.0	65.0	68.0	67.0	66.0	67.0	66.0	67.0	68.0	69.0	68.0	67.0	69.0	70.0	69.0	68.0	68.0	62.0
3:30 PM	52.0	65.0	67.0	68.0	68.0	68.0	67.0	69.0	69.0	69.0	70.0	69.0	69.0	70.0	69.0	68.0	66.0	49.0
3:45 PM	52.0	64.0	66.0	66.0	67.0	68.0	67.0	69.0	69.0	69.0	69.0	68.0	69.0	69.0	68.0	68.0	60.0	39.0
4:00 PM	53.0	66.0	69.0	69.0	70.0	69.0	69.0	70.0	70.0	70.0	69.0	69.0	69.0	71.0	69.0	69.0	61.0	33.0
4:15 PM	52.0	65.0	67.0	67.0	69.0	67.0	67.0	68.0	68.0	69.0	69.0	68.0	69.0	68.0	67.0	67.0	54.0	33.0
4:30 PM	53.0	65.0	66.0	68.0	68.0	68.0	68.0	69.0	68.0	69.0	70.0	68.0	70.0	69.0	69.0	69.0	64.0	43.0
4:45 PM	52.0	64.0	66.0	69.0	69.0	68.0	68.0	69.0	68.0	69.0	69.0	68.0	68.0	68.0	67.0	67.0	64.0	53.0
5:00 PM	51.0	64.0	65.0	66.0	68.0	69.0	69.0	70.0	69.0	70.0	69.0	70.0	69.0	70.0	69.0	70.0	70.0	66.0
5:15 PM	50.0	61.0	63.0	64.0	67.0	67.0	65.0	66.0	66.0	68.0	68.0	65.0	66.0	67.0	67.0	67.0	66.0	63.0
5:30 PM	49.0	62.0	62.0	64.0	66.0	65.0	67.0	68.0	66.0	67.0	70.0	69.0	67.0	69.0	68.0	68.0	69.0	67.0
5:45 PM	49.0	60.0	61.0	62.0	65.0	65.0	64.0	65.0	65.0	65.0	68.0	67.0	68.0	69.0	69.0	69.0	68.0	67.0
6:00 PM	49.0	61.0	62.0	62.0	66.0	67.0	66.0	69.0	66.0	67.0	67.0	68.0	69.0	69.0	69.0	69.0	69.0	67.0
6:15 PM	51.0	62.0	62.0	64.0	67.0	67.0	67.0	68.0	66.0	66.0	69.0	68.0	68.0	69.0	69.0	69.0	70.0	69.0
6:30 PM	51.0	64.0	66.0	66.0	66.0	67.0	67.0	68.0	67.0	67.0	70.0	70.0	69.0	71.0	71.0	70.0	71.0	71.0
6:45 PM	51.0	62.0	64.0	67.0	67.0	66.0	66.0	67.0	65.0	65.0	69.0	67.0	68.0	69.0	68.0	69.0	70.0	69.0
7:00 PM	49.0	63.0	65.0	66.0	68.0	68.0	69.0	70.0	67.0	67.0	69.0	69.0	68.0	69.0	69.0	71.0	72.0	71.0
7:15 PM	51.0	63.0	65.0	68.0	70.0	70.0	70.0	71.0	69.0	69.0	70.0	69.0	69.0	71.0	70.0	72.0	71.0	72.0
7:30 PM	53.0	64.0	65.0	67.0	68.0	69.0	70.0	71.0	70.0	70.0	70.0	70.0	69.0	71.0	70.0	72.0	72.0	72.0
7:45 PM	52.0	65.0	67.0	67.0	68.0	67.0	69.0	71.0	70.0	70.0	71.0	71.0	71.0	72.0	72.0	73.0	73.0	73.0
8:00 PM	52.0	64.0	67.0	69.0	69.0	70.0	71.0	72.0	69.0	70.0	69.0	70.0	70.0	71.0	70.0	71.0	71.0	70.0
8:15 PM	51.0	67.0	67.0	69.0	71.0	71.0	71.0	72.0	70.0	69.0	71.0	70.0	70.0	70.0	70.0	71.0	70.0	69.0
8:30 PM	51.0	63.0	66.0	68.0	68.0	70.0	71.0	71.0	70.0	71.0	70.0	70.0	70.0	71.0	71.0	71.0	71.0	70.0
8:45 PM	48.0	63.0	66.0	68.0	67.0	69.0	69.0	70.0	68.0	69.0	68.0	67.0	67.0	68.0	68.0	70.0	71.0	70.0
9:00 PM	51.0	66.0	68.0	67.0	68.0	70.0	69.0	72.0	70.0	70.0	70.0	70.0	70.0	69.0	70.0	70.0	71.0	71.0
9:15 PM	52.0	67.0	67.0	67.0	69.0	70.0	71.0	73.0	72.0	71.0	71.0	69.0	70.0	72.0	71.0	71.0	71.0	70.0
9:30 PM	53.0	67.0	67.0	69.0	69.0	71.0	71.0	73.0	70.0	72.0	71.0	72.0	71.0	71.0	71.0	70.0	71.0	71.0
9:45 PM	51.0	64.0	68.0	65.0	68.0	68.0	70.0	69.0	68.0	70.0	70.0	71.0	70.0	70.0	71.0	72.0	72.0	70.0
10:00 PM	51.0	66.0	67.0	65.0	67.0	70.0	70.0	70.0	68.0	68.0	69.0	70.0	71.0	68.0	69.0	71.0	72.0	70.0
10:15 PM	51.0	67.0	69.0	65.0	70.0	71.0	71.0	73.0	71.0	71.0	70.0	71.0	72.0	72.0	70.0	72.0	72.0	72.0
10:30 PM	52.0	65.0	67.0	67.0	68.0	71.0	70.0	71.0	72.0	71.0	67.0	70.0	69.0	66.0	66.0	66.0	68.0	67.0
10:45 PM	52.0	66.0	67.0	66.0	68.0	69.0	69.0	71.0	69.0	69.0	70.0	69.0	70.0	70.0	70.0	68.0	69.0	69.0
11:00 PM	52.0	63.0	63.0	65.0	66.0	67.0	67.0	67.0	65.0	65.0	65.0	65.0	65.0	66.0	65.0	65.0	66.0	66.0
11:15 PM	52.0	67.0	64.0	64.0	65.0	67.0	69.0	68.0	69.0	68.0	64.0	63.0	66.0	66.0	66.0	66.0	66.0	65.0
11:30 PM	52.0	62.0	65.0	64.0	67.0	66.0	66.0	68.0	66.0	67.0	67.0	65.0	69.0	65.0	65.0	66.0	65.0	65.0
11:45 PM	50.0	59.0	61.0	62.0	63.0	63.0	63.0	64.0	63.0	64.0	63.0	63.0	63.0	63.0	63.0	64.0	64.0	64.0

Target Time	Sycamore Valley Rd Off-Ramp to Sycamore Valley Rd On-Ramp	Sycamore Valley Rd On-Ramp to Diablo Rd Off-Ramp	Diablo Rd Off-Ramp to Diablo Rd Loop On-Ramp	Diablo Rd Loop On-Ramp to Diablo Rd Diag On-Ramp	Diablo Rd Diag On-Ramp to El Cerro Blvd Off-Ramp	El Cerro Blvd Off-Ramp to El Cerro Blvd On-Ramp	El Cerro Blvd On-Ramp to El Rio Rd On-Ramp	El Rio Rd On-Ramp to North of Alamo Springs Dr	North of Alamo Springs Dr to Stone Valley Rd Diag Off-Ramp	Stone Valley Rd Diag Off-Ramp to Stone Valley Rd Loop Off-Ramp	Stone Valley Rd Loop Off-Ramp to Stone Valley Rd On-Ramp	Stone Valley Rd On-Ramp to Livorna Rd Off-Ramp	Livorna Rd Off-Ramp to Livorna Rd On-Ramp	Livorna Rd On-Ramp to Rudgear Rd Off-Ramp	Rudgear Rd Off-Ramp to Danville Blvd On-Ramp	Danville Blvd On-Ramp to Main St Off-Ramp	Main St Off-Ramp to S Main St
12:00 AM	63.0	64.0	65.0	65.0	64.0	64.0	64.0	66.0	66.0	64.0	63.0	63.0	62.0	62.0	62.0	61.0	53.0
12:15 AM	63.0	63.0	64.0	61.0	61.0	61.0	63.0	63.0	64.0	62.0	62.0	62.0	61.0	63.0	64.0	63.0	56.0
12:30 AM	62.0	62.0	61.0	62.0	62.0	61.0	62.0	63.0	63.0	62.0	61.0	62.0	61.0	62.0	63.0	62.0	56.0
12:45 AM	63.0	62.0	62.0	62.0	61.0	62.0	61.0	63.0	63.0	62.0	61.0	61.0	61.0	61.0	62.0	61.0	55.0
1:00 AM	62.0	62.0	62.0	61.0	61.0	60.0	61.0	62.0	62.0	61.0	61.0	61.0	60.0	60.0	61.0	61.0	54.0
1:15 AM	62.0	62.0	61.0	62.0	61.0	61.0	61.0	62.0	62.0	62.0	61.0	61.0	61.0	62.0	63.0	62.0	52.0
1:30 AM	63.0	62.0	62.0	63.0	62.0	62.0	62.0	63.0	63.0	62.0	62.0	62.0	62.0	63.0	62.0	61.0	48.0
1:45 AM	62.0	62.0	62.0	61.0	61.0	61.0	61.0	62.0	63.0	62.0	61.0	61.0	61.0	61.0	62.0	62.0	49.0
2:00 AM	61.0	61.0	62.0	61.0	61.0	61.0	61.0	63.0	62.0	62.0	61.0	61.0	60.0	62.0	62.0	61.0	51.0
2:15 AM	61.0	61.0	61.0	61.0	61.0	61.0	61.0	62.0	62.0	61.0	61.0	61.0	60.0	61.0	62.0	62.0	51.0
2:30 AM	62.0	61.0	63.0	62.0	61.0	61.0	61.0	62.0	62.0	61.0	61.0	61.0	61.0	61.0	61.0	61.0	52.0
2:45 AM	62.0	62.0	62.0	61.0	61.0	61.0	62.0	63.0	63.0	61.0	62.0	61.0	61.0	61.0	61.0	61.0	51.0
3:00 AM	63.0	62.0	62.0	61.0	60.0	61.0	61.0	62.0	62.0	61.0	61.0	61.0	60.0	60.0	61.0	61.0	47.0
3:15 AM	62.0	61.0	60.0	62.0	61.0	62.0	62.0	63.0	63.0	63.0	62.0	60.0	60.0	60.0	61.0	61.0	48.0
3:30 AM	62.0	60.0	60.0	62.0	61.0	61.0	62.0	63.0	63.0	62.0	62.0	62.0	61.0	62.0	62.0	62.0	46.0
3:45 AM	63.0	62.0	63.0	61.0	61.0	61.0	61.0	63.0	62.0	62.0	61.0	61.0	61.0	62.0	62.0	61.0	46.0
4:00 AM	63.0	62.0	62.0	62.0	62.0	62.0	63.0	64.0	63.0	63.0	63.0	63.0	62.0	63.0	64.0	62.0	44.0
4:15 AM	65.0	64.0	63.0	63.0	63.0	62.0	63.0	64.0	64.0	63.0	63.0	63.0	63.0	63.0	63.0	63.0	45.0
4:30 AM	63.0	62.0	62.0	63.0	62.0	62.0	63.0	65.0	65.0	63.0	62.0	63.0	62.0	63.0	64.0	62.0	46.0
4:45 AM	64.0	63.0	63.0	63.0	62.0	64.0	65.0	66.0	66.0	65.0	64.0	64.0	64.0	65.0	65.0	63.0	48.0
5:00 AM	68.0	66.0	67.0	67.0	66.0	66.0	66.0	67.0	67.0	67.0	65.0	65.0	64.0	64.0	65.0	64.0	49.0
5:15 AM	66.0	66.0	66.0	65.0	65.0	65.0	65.0	66.0	69.0	69.0	69.0	68.0	68.0	68.0	67.0	66.0	51.0
5:30 AM	66.0	65.0	65.0	65.0	66.0	66.0	64.0	66.0	65.0	65.0	63.0	65.0	63.0	65.0	66.0	65.0	52.0
5:45 AM	66.0	65.0	65.0	65.0	66.0	66.0	67.0	69.0	69.0	68.0	69.0	68.0	67.0	67.0	68.0	68.0	52.0
6:00 AM	67.0	64.0	64.0	65.0	65.0	65.0	66.0	68.0	68.0	68.0	66.0	66.0	65.0	65.0	67.0	66.0	49.0
6:15 AM	66.0	65.0	67.0	67.0	67.0	66.0	67.0	68.0	69.0	67.0	66.0	65.0	65.0	66.0	68.0	67.0	45.0
6:30 AM	68.0	67.0	69.0	68.0	68.0	68.0	68.0	69.0	70.0	69.0	66.0	67.0	67.0	69.0	70.0	69.0	45.0
6:45 AM	68.0	68.0	69.0	68.0	67.0	67.0	68.0	69.0	70.0	69.0	69.0	68.0	69.0	69.0	70.0	68.0	44.0
7:00 AM	69.0	67.0	68.0	68.0	69.0	67.0	67.0	69.0	68.0	68.0	66.0	67.0	67.0	68.0	69.0	68.0	48.0
7:15 AM	69.0	65.0	67.0	66.0	66.0	66.0	65.0	69.0	69.0	69.0	67.0	66.0	67.0	68.0	70.0	70.0	44.0
7:30 AM	65.0	59.0	60.0	58.0	55.0	54.0	55.0	61.0	63.0	61.0	60.0	59.0	60.0	63.0	66.0	66.0	41.0
7:45 AM	53.0	45.0	48.0	47.0	44.0	42.0	45.0	51.0	53.0	54.0	45.0	50.0	51.0	57.0	64.0	66.0	43.0
8:00 AM	37.0	35.0	42.0	38.0	38.0	38.0	42.0	50.0	52.0	55.0	53.0	52.0	51.0	57.0	65.0	66.0	44.0
8:15 AM	27.0	30.0	33.0	32.0	33.0	35.0	39.0	50.0	53.0	53.0	46.0	46.0	46.0	54.0	64.0	65.0	44.0
8:30 AM	31.0	33.0	37.0	36.0	36.0	35.0	38.0	49.0	52.0	51.0	48.0	46.0	47.0	56.0	65.0	66.0	45.0
8:45 AM	29.0	29.0	32.0	33.0	33.0	34.0	39.0	50.0	53.0	50.0	44.0	45.0	49.0	53.0	65.0	67.0	45.0
9:00 AM	45.0	43.0	45.0	43.0	41.0	36.0	38.0	50.0	52.0	45.0	42.0	37.0	37.0	51.0	64.0	68.0	44.0
9:15 AM	66.0	64.0	64.0	64.0	63.0	59.0	58.0	56.0	52.0	38.0	33.0	36.0	33.0	47.0	63.0	67.0	46.0
9:30 AM	68.0	65.0	66.0	67.0	66.0	66.0	67.0	68.0	68.0	67.0	66.0	64.0	53.0	56.0	64.0	67.0	45.0
9:45 AM	68.0	66.0	68.0	68.0	67.0	68.0	69.0	69.0	69.0	69.0	68.0	67.0	67.0	66.0	66.0	69.0	44.0
10:00 AM	67.0	66.0	65.0	66.0	66.0	67.0	68.0	68.0	69.0	68.0	70.0	67.0	66.0	66.0	68.0	69.0	43.0
10:15 AM	68.0	66.0	65.0	66.0	65.0	65.0	66.0	68.0	69.0	70.0	69.0	68.0	67.0	67.0	68.0	69.0	48.0
10:30 AM	70.0	67.0	68.0	68.0	68.0	68.0	69.0	71.0	70.0	70.0	69.0	69.0	68.0	67.0	68.0	69.0	46.0
10:45 AM	71.0	68.0	69.0	70.0	70.0	68.0	68.0	70.0	70.0	71.0	68.0	70.0	69.0	68.0	70.0	71.0	43.0
11:00 AM	67.0	65.0	67.0	68.0	67.0	68.0	69.0	69.0	68.0	67.0	68.0	68.0	67.0	65.0	68.0	69.0	41.0
11:15 AM	68.0	66.0	66.0	65.0	65.0	66.0	69.0	69.0	66.0	68.0	68.0	68.0	67.0	67.0	67.0	68.0	43.0
11:30 AM	68.0	66.0	67.0	67.0	66.0	67.0	68.0	69.0	68.0	68.0	68.0	67.0	67.0	67.0	68.0	70.0	46.0
11:45 AM	68.0	64.0	66.0	66.0	66.0	66.0	68.0	71.0	70.0	69.0	67.0	68.0	69.0	69.0	69.0	68.0	48.0
12:00 PM	70.0	67.0	68.0	68.0	67.0	67.0	69.0	70.0	70.0	69.0	68.0	70.0	69.0	67.0	69.0	69.0	48.0
12:15 PM	67.0	66.0	68.0	68.0	67.0	66.0	68.0	69.0	70.0	69.0	68.0	67.0	66.0	67.0	68.0	69.0	47.0
12:30 PM	68.0	66.0	66.0	67.0	66.0	66.0	67.0	69.0	68.0	69.0	70.0	67.0	67.0	67.0	69.0	70.0	49.0
12:45 PM	71.0	68.0	69.0	69.0	67.0	68.0	71.0	70.0	70.0	70.0	70.0	69.0	69.0	68.0	68.0	69.0	43.0
1:00 PM	67.0	66.0	66.0	68.0	67.0	67.0	68.0	69.0	69.0	68.0	66.0	68.0	67.0	67.0	69.0	70.0	46.0
1:15 PM	70.0	67.0	67.0	67.0	66.0	67.0	68.0	70.0	68.0	69.0	69.0	69.0	67.0	67.0	69.0	68.0	50.0
1:30 PM	69.0	66.0	68.0	68.0	69.0	69.0	69.0	70.0	71.0	70.0	68.0	67.0	67.0	65.0	66.0	70.0	50.0
1:45 PM	69.0	69.0	69.0	68.0	67.0	68.0	68.0	70.0	70.0	68.0	67.0	65.0	64.0	64.0	67.0	69.0	49.0
2:00 PM	71.0	67.0	69.0	69.0	69.0	68.0	67.0	68.0	69.0	67.0	66.0	66.0	65.0	65.0	66.0	68.0	45.0
2:15 PM	69.0	67.0	68.0	68.0	68.0	68.0	67.0	67.0	69.0	67.0	66.0	63.0	58.0	60.0	67.0	67.0	47.0
2:30 PM	70.0	65.0	67.0	66.0	65.0	66.0	67.0	68.0	67.0	62.0	57.0	50.0	35.0	48.0	64.0	67.0	45.0
2:45 PM	69.0	66.0	67.0	66.0	65.0	65.0	63.0	57.0	49.0	41.0	34.0	28.0	28.0	46.0	62.0	65.0	44.0
3:00 PM	68.0	64.0	63.0	64.0	65.0	53.0	45.0	44.0	42.0	35.0	31.0	27.0	28.0	44.0	58.0	57.0	41.0
3:15 PM	49.0	41.0	40.0	36.0	35.0	33.0	37.0	38.0	34.0	30.0	28.0	31.0	31.0	46.0	54.0	52.0	38.0
3:30 PM	31.0	31.0	27.0	28.0	30.0	27.0	31.0	41.0	43.0	37.0	32.0	32.0	32.0	47.0	48.0	33.0	38.0
3:45 PM	30.0	28.0	28.0	29.0	28.0	28.0	32.0	39.0	39.0	34.0	29.0	31.0	32.0	43.0	31.0	25.0	38.0
4:00 PM	25.0	27.0	27.0	26.0	26.0	26.0	29.0	35.0	35.0	31.0	28.0	28.0	29.0	33.0	24.0	20.0	36.0
4:15 PM	26.0	28.0	26.0	25.0	25.0	24.0	25.0	28.0	30.0	28.0	25.0	28.0	29.0	32.0	22.0	20.0	36.0
4:30 PM	28.0	27.0	26.0	24.0	24.0	25.0	25.0	32.0	33.0	30.0	26.0	29.0	29.0	30.0	23.0	20.0	34.0
4:45 PM	29.0	28.0	26.0	26.0	25.0	22.0	25.0	31.0	29.0	26.0	24.0	26.0	25.0	29.0	20.0	19.0	33.0
5:00 PM	43.0	32.0	28.0	24.0	23.0	23.0	22.0	26.0	29.0	28.0	25.0	27.0	26.0	29.0	20.0	19.0	35.0
5:15 PM	37.0	33.0	29.0	27.0	26.0	27.0	27.0	32.0	30.0	28.0	25.0	27.0	26.0	26.0	19.0	17.0	33.0
5:30 PM	45.0	33.0	30.0	28.0	26.0	24.0	23.0	26.0	30.0	25.0	23.0	25.0	25.0	26.0	20.0	21.0	34.0
5:45 PM	52.0	41.0	44.0	37.0	30.0	29.0	29.0	32.0	31.0	27.0	24.0	28.0	28.0	30.0	24.0	22.0	33.0
6:00 PM	65.0	63.0	60.0	54.0	44.0	41.0	35.0	36.0	40.0	38.0	35.0	34.0	32.0	30.0	21.0	20.0	33.0
6:15 PM	66.0	63.0	65.0	64.0	62.0	63.0	64.0	62.0	60.0	54.0	51.0	47.0	40.0	30.0	22.0	20.0	33.0
6:30 PM	68.0	66.0	66.0	66.0	66.0	67.0	67.0	66.0	66.0	65.0	63.0	63.0	61.0	50.0	32.0	25.0	36.0
6:45 PM	68.0	65.0	66.0	66.0	66.0	64.0	67.0	67.0	67.0	66.0	64.0	62.0	62.0	62.0	56.0	45.0	37.0
7:00 PM	68.0	66.0	68.0	67.0	65.0	67.0	69.0	70.0	70.0	70.0	69.0	69.0	68.0	68.0	66.0	65.0	41.0
7:15 PM	69.0	68.0	69.0	68.0	69.0	69.0	69.0	72.0	71.0	70.0	68.0	69.0	70.0	69.0	70.0	69.0	42.0
7:30 PM	71.0	69.0	70.0	71.0	70.0	69.0	70.0	72.0	72.0	71.0	71.0	70.0	68.0	71.0	70.0	69.0	43.0
7:45 PM	72.0	71.0	70.0	70.0	69.0	68.0	69.0	72.0	71.0	71.0	70.0	69.0	68.0	69.0	69.0	69.0	53.0
8:00 PM	68.0	68.0	69.0	68.0	66.0	67.0	68.0	72.0	72.0	71.0	69.0	69.0	69.0	69.0	69.0	68.0	57.0
8:15 PM	68.0	68.0	69.0	69.0	68.0	67.0	69.0	71.0	71.0	68.0	66.0	67.0	67.0	67.0	70.0	69.0	59.0
8:30 PM	67.0	67.0	67.0	70.0	68.0	67.0	67.0	69.0	68.0	67.0	67.0	67.0	66.0	66.0	68.0	68.0	59.0
8:45 PM	69.0	69.0	69.0	70.0	69.0	67.0	69.0	70.0	70.0	68.0	69.0	69.0	67.0	68.0	69.0	66.0	58.0
9:00 PM	72.0	68.0	69.0	69.0	67.0	68.0	70.0	72.0	72.0	71.0	70.0	70.0	71.0	70.0	69.0	70.0	54.0
9:15 PM	69.0	67.0	70.0	69.0	69.0	70.0	70.0	70.0	70.0	71.0	69.0	70.0	68.0	68.0	69.0	69.0	53.0
9:30 PM	69.0	68.0	69.0	69.0	68.0	69.0	70.0	71.0	71.0	70.0	71.0	69.0	69.0	71.0	69.0	69.0	53.0
9:45 PM	69.0	68.0	69.0	70.0	69.0	66.0	69.0	71.0	69.0	69.0	69.0	69.0	68.0	68.0	68.0	69.0	51.0
10:00 PM	68.0	68.0	67.0	70.0	67.0	68.0	67.0	70.0	70.0	68.0	68.0	67.0	67.0	68.0	68.0	68.0	51.0
10:15 PM	71.0	71.0	70.0	70.0	69.0	70.0	71.0	73.0	72.0	71.0	71.0	71.0	69.0	70.0	71.0	71.0	51.0
10:30 PM	66.0	66.0	66.0	66.0	65.0	64.0	66.0	68.0	69.0	70.0	70.0	67.0	66.0	69.0	70.0	70.0	52.0
10:45 PM	69.0	65.0	64.0	63.0	63.0	63.0	65.0	65.0	66.0	64.0	64.0	66.0	65.0	63.0	64.0	64.0	54.0
11:00 PM	66.0	65.0	66.0	68.0	66.0	66.0	66.0	69.0	67.0	69.0	68.0	67.0	66.0	68.0	67.0	69.0	57.0
11:15 PM	65.0	64.0	63.0	64.0	62.0	63.0	63.0	63.0	66.0	63.0	62.0	65.0	63.0	64.0	63.0	64.0	57.0
11:30 PM	64.0	64.0	64.0	66.0	64.0	64.0	63.0	64.0	66.0	67.0	63.0	66.0	65.0	66.0	66.0	63.0	58.0
11:45 PM	64.0	64.0	63.0	63.0	63.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	63.0	63.0	63.0	62.0	57.0

Green	Greater than 55 mph
Yellow	45 to 55 mph
Orange	35 to 45 mph
Red	Less than 35 mph

Figure 39: Speed Contours, I-680 Study Corridor Northbound, After Study (2018)

I-680 Northbound 50th Percentile Speeds After Study (2018)

Target Time	I-580 Off-Ramp to I-580 On-Ramp	I-580 On-Ramp to Village Pkwy On-Ramp	Village Pkwy On-Ramp to West of Canterbury Ln	West of Canterbury Ln to Alcosta Blvd Off-Ramp	Alcosta Blvd Off-Ramp to Alcosta Blvd On-Ramp	Alcosta Blvd On-Ramp to West of Winthrop Ave	West of Winthrop Ave to West of Pine Valley Rd	West of Pine Valley Rd to West of Waterbury Way	West of Waterbury Way to West of Soccer Fields	West of Soccer Fields to Bollinger Canyon Rd Off-Ramp	Bollinger Canyon Rd Off-Ramp to Bollinger Canyon Rd Loop On-Ramp	Bollinger Canyon Rd Loop On-Ramp to Bollinger Canyon Rd Diag. On-Ramp	Bollinger Canyon Rd Diag. On-Ramp to Crow Canyon Rd Off-Ramp	Crow Canyon Rd Off-Ramp to Crow Canyon Rd Loop On-Ramp	Crow Canyon Rd Loop On-Ramp to Crow Canyon Rd Diag On-Ramp	Crow Canyon Rd Diag On-Ramp to West of Mission Pl	West of Mission Pl to West of Delta Way	West of Delta Way to Sycamore Valley Rd Off-Ramp
12:00 AM	50.0	69.0	69.0	66.0	65.0	66.0	67.0	67.0	67.0	67.0	67.0	68.0	68.0	68.0	69.0	70.0	68.0	70.0
12:15 AM	50.0	58.0	60.0	61.0	62.0	62.0	61.0	62.0	62.0	63.0	62.0	62.0	62.0	62.0	62.0	63.0	63.0	64.0
12:30 AM	51.0	63.0	66.0	65.0	64.0	65.0	65.0	66.0	66.0	66.0	65.0	65.0	65.0	65.0	65.0	66.0	65.0	66.0
12:45 AM	50.0	69.0	69.0	65.0	65.0	66.0	67.0	67.0	67.0	68.0	67.0	68.0	69.0	68.0	69.0	71.0	68.0	71.0
1:00 AM	50.0	68.0	69.0	65.0	64.0	65.0	65.0	66.0	65.0	66.0	66.0	67.0	69.0	66.0	67.0	69.0	67.0	70.0
1:15 AM	50.0	69.0	70.0	66.0	65.0	65.0	66.0	66.0	68.0	67.0	67.0	68.0	69.0	67.0	69.0	70.0	68.0	71.0
1:30 AM	51.0	69.0	69.0	66.0	65.0	66.0	66.0	66.0	66.0	67.0	67.0	67.0	69.0	68.0	68.0	69.0	68.0	70.0
1:45 AM	51.0	69.0	69.0	66.0	65.0	65.0	67.0	67.0	65.0	67.0	67.0	68.0	68.0	68.0	68.0	70.0	69.0	71.0
2:00 AM	50.0	68.0	69.0	65.0	64.0	64.0	65.0	65.0	65.0	65.0	66.0	67.0	68.0	67.0	68.0	70.0	68.0	71.0
2:15 AM	51.0	69.0	69.0	66.0	65.0	66.0	66.0	66.0	66.0	67.0	67.0	67.0	69.0	68.0	67.0	69.0	68.0	71.0
2:30 AM	50.0	69.0	69.0	66.0	64.0	65.0	66.0	66.0	67.0	66.0	66.0	67.0	69.0	67.0	68.0	68.0	68.0	71.0
2:45 AM	51.0	68.0	69.0	67.0	66.0	66.0	67.0	67.0	67.0	67.0	67.0	68.0	69.0	68.0	69.0	70.0	68.0	71.0
3:00 AM	50.0	68.0	69.0	66.0	66.0	66.0	67.0	67.0	68.0	68.0	68.0	69.0	69.0	68.0	69.0	70.0	70.0	70.0
3:15 AM	50.0	67.0	68.0	66.0	64.0	65.0	66.0	67.0	65.0	66.0	66.0	67.0	68.0	67.0	68.0	69.0	68.0	70.0
3:30 AM	51.0	67.0	68.0	66.0	66.0	65.0	66.0	67.0	65.0	66.0	66.0	67.0	68.0	67.0	68.0	69.0	68.0	70.0
3:45 AM	51.0	66.0	67.0	65.0	64.0	65.0	65.0	66.0	66.0	66.0	66.0	66.0	67.0	66.0	67.0	68.0	68.0	69.0
4:00 AM	50.0	67.0	67.0	67.0	65.0	65.0	65.0	67.0	66.0	66.0	66.0	66.0	68.0	66.0	67.0	68.0	69.0	68.0
4:15 AM	51.0	68.0	69.0	66.0	65.0	65.0	66.0	67.0	66.0	66.0	66.0	67.0	69.0	66.0	67.0	68.0	68.0	70.0
4:30 AM	49.0	67.0	69.0	66.0	64.0	65.0	66.0	67.0	66.0	66.0	66.0	66.0	69.0	66.0	67.0	70.0	70.0	72.0
4:45 AM	49.0	68.0	68.0	65.0	65.0	66.0	67.0	68.0	66.0	66.0	66.0	68.0	69.0	68.0	67.0	69.0	70.0	72.0
5:00 AM	48.0	68.0	69.0	67.0	65.0	65.0	67.0	68.0	65.0	67.0	66.0	69.0	70.0	68.0	70.0	71.0	70.0	72.0
5:15 AM	49.0	68.0	68.0	65.0	65.0	65.0	66.0	67.0	66.0	65.0	66.0	67.0	68.0	67.0	68.0	70.0	69.0	70.0
5:30 AM	48.0	68.0	68.0	68.0	66.0	67.0	67.0	68.0	68.0	68.0	69.0	68.0	69.0	68.0	69.0	70.0	70.0	72.0
5:45 AM	50.0	69.0	69.0	68.0	68.0	67.0	68.0	68.0	68.0	68.0	68.0	67.0	69.0	68.0	69.0	71.0	71.0	72.0
6:00 AM	51.0	68.0	68.0	68.0	68.0	67.0	68.0	68.0	67.0	69.0	68.0	69.0	69.0	69.0	69.0	70.0	71.0	72.0
6:15 AM	51.0	67.0	67.0	66.0	66.0	66.0	66.0	68.0	67.0	69.0	68.0	70.0	70.0	69.0	71.0	71.0	71.0	72.0
6:30 AM	50.0	65.0	65.0	64.0	64.0	63.0	64.0	65.0	65.0	64.0	65.0	66.0	66.0	67.0	67.0	69.0	69.0	70.0
6:45 AM	50.0	64.0	67.0	64.0	64.0	64.0	65.0	66.0	65.0	65.0	66.0	66.0	66.0	67.0	69.0	70.0	69.0	69.0
7:00 AM	51.0	67.0	66.0	64.0	65.0	64.0	65.0	66.0	65.0	65.0	66.0	67.0	68.0	68.0	68.0	70.0	70.0	70.0
7:15 AM	51.0	64.0	64.0	64.0	65.0	64.0	64.0	66.0	65.0	65.0	66.0	66.0	66.0	68.0	67.0	69.0	70.0	70.0
7:30 AM	51.0	60.0	60.0	61.0	63.0	60.0	62.0	66.0	65.0	66.0	67.0	66.0	67.0	69.0	70.0	70.0	70.0	69.0
7:45 AM	48.0	53.0	48.0	47.0	54.0	54.0	60.0	63.0	65.0	66.0	68.0	67.0	68.0	69.0	69.0	70.0	70.0	65.0
8:00 AM	48.0	55.0	49.0	46.0	43.0	44.0	57.0	64.0	64.0	65.0	67.0	65.0	67.0	70.0	69.0	70.0	70.0	61.0
8:15 AM	48.0	53.0	48.0	47.0	45.0	49.0	61.0	64.0	65.0	66.0	68.0	67.0	68.0	69.0	68.0	70.0	70.0	67.0
8:30 AM	49.0	53.0	51.0	46.0	41.0	45.0	58.0	63.0	64.0	64.0	66.0	65.0	67.0	67.0	67.0	68.0	68.0	65.0
8:45 AM	49.0	58.0	50.0	39.0	43.0	45.0	55.0	63.0	62.0	65.0	67.0	66.0	68.0	68.0	68.0	70.0	70.0	59.0
9:00 AM	49.0	61.0	60.0	48.0	49.0	58.0	61.0	64.0	65.0	65.0	68.0	66.0	67.0	70.0	68.0	70.0	68.0	59.0
9:15 AM	51.0	65.0	65.0	65.0	65.0	63.0	65.0	68.0	67.0	66.0	65.0	65.0	68.0	67.0	66.0	66.0	67.0	66.0
9:30 AM	51.0	64.0	65.0	66.0	65.0	66.0	66.0	68.0	68.0	67.0	68.0	67.0	68.0	69.0	68.0	68.0	69.0	68.0
9:45 AM	51.0	65.0	68.0	68.0	67.0	66.0	66.0	67.0	67.0	67.0	68.0	67.0	68.0	69.0	68.0	69.0	69.0	68.0
10:00 AM	52.0	66.0	67.0	67.0	66.0	66.0	67.0	68.0	67.0	66.0	67.0	65.0	65.0	70.0	67.0	69.0	70.0	70.0
10:15 AM	50.0	65.0	66.0	65.0	66.0	66.0	65.0	66.0	65.0	67.0	67.0	67.0	67.0	67.0	67.0	68.0	70.0	70.0
10:30 AM	49.0	65.0	66.0	67.0	67.0	66.0	67.0	68.0	67.0	67.0	67.0	66.0	67.0	67.0	67.0	68.0	70.0	68.0
10:45 AM	50.0	67.0	68.0	68.0	67.0	66.0	67.0	70.0	69.0	70.0	69.0	68.0	68.0	69.0	69.0	70.0	72.0	71.0
11:00 AM	50.0	66.0	68.0	68.0	68.0	69.0	69.0	68.0	69.0	68.0	71.0	68.0	68.0	69.0	69.0	70.0	70.0	71.0
11:15 AM	52.0	65.0	66.0	66.0	67.0	66.0	67.0	68.0	67.0	68.0	68.0	68.0	70.0	68.0	66.0	70.0	71.0	71.0
11:30 AM	52.0	64.0	68.0	68.0	68.0	68.0	67.0	69.0	69.0	68.0	69.0	67.0	67.0	69.0	68.0	69.0	70.0	71.0
11:45 AM	53.0	66.0	68.0	69.0	68.0	68.0	68.0	71.0	69.0	69.0	69.0	68.0	69.0	71.0	67.0	68.0	70.0	70.0
12:00 PM	53.0	67.0	69.0	68.0	68.0	68.0	67.0	67.0	67.0	68.0	66.0	66.0	66.0	69.0	70.0	71.0	72.0	71.0
12:15 PM	52.0	66.0	67.0	67.0	66.0	66.0	68.0	69.0	68.0	68.0	67.0	67.0	67.0	67.0	68.0	68.0	70.0	70.0
12:30 PM	53.0	67.0	69.0	69.0	69.0	69.0	71.0	72.0	70.0	71.0	70.0	70.0	71.0	70.0	68.0	71.0	73.0	72.0
12:45 PM	54.0	66.0	66.0	67.0	68.0	68.0	66.0	69.0	68.0	70.0	70.0	69.0	70.0	70.0	71.0	70.0	72.0	73.0
1:00 PM	52.0	66.0	67.0	67.0	68.0	68.0	67.0	68.0	67.0	68.0	69.0	66.0	69.0	71.0	70.0	70.0	72.0	71.0
1:15 PM	53.0	67.0	68.0	68.0	68.0	67.0	67.0	69.0	67.0	69.0	68.0	68.0	67.0	69.0	68.0	70.0	72.0	71.0
1:30 PM	53.0	64.0	66.0	67.0	68.0	67.0	67.0	68.0	67.0	70.0	69.0	67.0	68.0	70.0	70.0	71.0	73.0	72.0
1:45 PM	53.0	66.0	70.0	69.0	68.0	68.0	67.0	71.0	70.0	71.0	71.0	69.0	70.0	73.0	72.0	72.0	74.0	73.0
2:00 PM	53.0	66.0	66.0	67.0	67.0	67.0	67.0	68.0	68.0	70.0	70.0	69.0	70.0	70.0	69.0	71.0	72.0	72.0
2:15 PM	53.0	65.0	68.0	68.0	69.0	68.0	67.0	69.0	69.0	68.0	69.0	67.0	68.0	69.0	69.0	69.0	70.0	68.0
2:30 PM	52.0	66.0	67.0	68.0	68.0	69.0	69.0	69.0	68.0	69.0	70.0	68.0	68.0	70.0	68.0	70.0	70.0	68.0
2:45 PM	55.0	66.0	69.0	68.0	68.0	67.0	66.0	69.0	68.0	71.0	70.0	68.0	67.0	70.0	68.0	69.0	68.0	65.0
3:00 PM	52.0	67.0	69.0	69.0	71.0	69.0	68.0	70.0	69.0	71.0	72.0	69.0	69.0	70.0	69.0	69.0	70.0	70.0
3:15 PM	52.0	65.0	68.0	68.0	68.0	67.0	66.0	67.0	68.0	69.0	71.0	68.0	69.0	70.0	69.0	70.0	68.0	53.0
3:30 PM	52.0	65.0	68.0	67.0	68.0	67.0	66.0	69.0	70.0	69.0	71.0	69.0	68.0	70.0	68.0	68.0	63.0	41.0
3:45 PM	52.0	64.0	66.0	67.0	67.0	67.0	65.0	67.0	67.0	68.0	68.0	67.0	67.0	68.0	66.0	64.0	56.0	34.0
4:00 PM	52.0	66.0	67.0	69.0	68.0	68.0	68.0	70.0	69.0	69.0	68.0	66.0	66.0	66.0	66.0	64.0	59.0	35.0
4:15 PM	52.0	65.0	67.0	67.0	68.0	68.0	67.0	69.0	69.0	69.0	69.0	67.0	68.0	68.0	67.0	62.0	64.0	43.0
4:30 PM	50.0	64.0	66.0	67.0	68.0	68.0	67.0	69.0	69.0	69.0	70.0	67.0	68.0	70.0	68.0	67.0	67.0	59.0
4:45 PM	50.0	63.0	65.0	67.0	67.0	67.0	67.0	69.0	68.0	68.0	70.0	69.0	68.0	67.0	65.0	66.0	67.0	59.0
5:00 PM	51.0	64.0	67.0	67.0	69.0	67.0	67.0	70.0	69.0	69.0	69.0	67.0	69.0	70.0	68.0	68.0	68.0	66.0
5:15 PM	49.0	61.0	63.0	63.0	65.0	62.0	63.0	66.0	65.0	65.0	67.0	67.0	67.0	67.0	67.0	61.0	64.0	59.0
5:30 PM	50.0	59.0	63.0	61.0	59.0	59.0	59.0	63.0	64.0	63.0	64.0	64.0	63.0	65.0	65.0	67.0	64.0	57.0
5:45 PM	48.0	60.0	61.0	62.0	62.0	62.0	62.0	64.0	64.0	63.0	65.0	63.0	64.0	66.0	64.0	67.0	62.0	56.0
6:00 PM	48.0	59.0	61.0	61.0	63.0	63.0	62.0	63.0	62.0	63.0	66.0	64.0	65.0	68.0	66.0	67.0	68.0	67.0
6:15 PM	49.0	61.0	62.0	64.0	64.0	65.0	64.0	64.0	64.0	66.0	68.0	66.0	66.0	68.0	66.0	67.0	67.0	67.0
6:30 PM	50.0	62.0	64.0	65.0	66.0	66.0	66.0	68.0	67.0	66.0	69.0	67.0	67.0	69.0	68.0	70.0	69.0	67.0
6:45 PM	50.0	63.0	64.0	65.0	67.0	66.0	66.0	69.0	67.0	67.0	68.0	67.0	69.0	70.0	69.0	70.0	69.0	69.0
7:00 PM	50.0	63.0	65.0	65.0	67.0	67.0	67.0	69.0	69.0	67.0	69.0	67.0	68.0	71.0	69.0	72.0	72.0	70.0
7:15 PM	50.0	62.0	65.0	67.0	68.0	67.0	67.0	67.0	66.0	66.0	69.0	69.0	68.0	70.0	69.0	71.0	71.0	72.0
7:30 PM	52.0	64.0	66.0	67.0	67.0	67.0	67.0	68.0	67.0	67.0	69.0	68.0	68.0	70.0	70.0	70.0	71.0	71.0
7:45 PM	51.0	62.0	65.0	68.0	70.0	68.0	69.0	70.0	68.0	68.0	70.0	69.0	71.0	71.0	70.0	71.0	71.0	71.0
8:00 PM	51.0	67.0	68.0	69.0	70.0	70.0	69.0	72.0	72.0	70.0	70.0	70.0	70.0	71.0	72.0	72.0	72.0	72.0
8:15 PM	52.0	65.0	67.0	69.0	71.0	71.0	70.0	71.0	71.0	70.0	71.0	70.0	69.0	71.0	71.0	72.0	72.0	72.0
8:30 PM	53.0	67.0	67.0	67.0	68.0	68.0	68.0	70.0	69.0	68.0	69.0	69.0	69.0	72.0	71.0	73.0	72.0	70.0
8:45 PM	52.0	67.0	68.0	67.0	67.0	68.0	68.0	69.0	68.0	68.0	69.0	68.0	69.0	70.0	70.0	71.0	71.0	71.0
9:00 PM	51.0	68.0	69.0	69.0	71.0	70.0	70.0	70.0	70.0	69.0	70.0	69.0	70.0	70.0	71.0	73.0	72.0	72.0
9:15 PM	53.0	68.0	70.0	70.0	70.0	71.0	70.0	72.0	72.0	70.0	72.0	72.0	71.0	72.0	72.0	73.0	74.0	74.0
9:30 PM	55.0	69.0	70.0	69.0	68.0	70.0	71.0	71.0	70.0	70.0	69.0	70.0	70.0	70.0	71.0	72.0	73.0	74.0
9:45 PM	51.0	69.0	69.0	68.0	68.0	69.0	69.0	70.0	70.0	70.0	70.0	69.0	70.0	71.0	71.0	71.0	71.0	72.0
10:00 PM	51.0	67.0	68.0	68.0	67.0	68.0	69.0	69.0	67.0	69.0	69.0	69.0	70.0	69.0	70.0	72.0	70.0	72.0
10:15 PM	50.0	69.0	69.0	68.0	67.0	68.0	69.0	69.0	69.0	69.0	68.0	69.0	70.0	70.0	71.0	72.0	70.0	72.0
10:30 PM	51.0	67.0	69.0	68.0	68.0	68.0	68.0	69.0	68.0	68.0	68.0	67.0	68.0	68.0	69.0	70.0	70.0	71.0
10:45 PM	50.0	68.0	67.0	68.0	67.0	68.0	69.0	68.0	68.0	68.0	69.0	68.0	69.0	69.0	70.0	71.0	71.0	71.0
11:00 PM	50.0	68.0	68.0	66.0	66.0	67.0	67.0	67.0	66.0	67.0	68.0	68.0	69.0	68.0	69.0	70.0	71.0	71.0
11:15 PM	51.0	68.0	68.0	64.0	65.0	66.0	67.0	67.0	66.0	67.0	67.0	67.0	67.0	67.0	69.0	72.0	71.0	71.0
11:30 PM	51.0	68.0	68.0	66.0	66.0	65.0	67.0	67.0	67.0	67.0	67.0	68.0	68.0	67.0	68.0	69.0	68.0	70.0
11:45 PM	50.0	69.0	68.0	65.0	65.0	67.0	67.0	67.0	67.0	68.0	68.0	68.0	69.0	67.0	69.0	69.0	69.0	71.0

Target Time	Sycamore Valley Rd Off-Ramp to Sycamore Valley Rd On-Ramp	Sycamore Valley Rd On-Ramp to Diablo Rd Off-Ramp	Diablo Rd Off-Ramp to Diablo Rd Loop On-Ramp	Diablo Rd Loop On-Ramp to Diablo Rd Diag On-Ramp	Diablo Rd Diag On-Ramp to El Cerro Blvd Off-Ramp	El Cerro Blvd Off-Ramp to El Cerro Blvd On-Ramp	El Cerro Blvd On-Ramp to El Rio Rd On-Ramp	El Rio Rd On-Ramp to North of Alamo Springs Dr	North of Alamo Springs Dr to Stone Valley Rd Diag Off-Ramp	Stone Valley Rd Diag Off-Ramp to Stone Valley Rd Loop Off-Ramp	Stone Valley Rd Loop Off-Ramp to Stone Valley Rd On-Ramp	Stone Valley Rd On-Ramp to Livorna Rd Off-Ramp	Livorna Rd Off-Ramp to Livorna Rd On-Ramp	Livorna Rd On-Ramp to Rudgear Rd Off-Ramp	Rudgear Rd Off-Ramp to Danville Blvd On-Ramp	Danville Blvd On-Ramp to Main St Off-Ramp	Main St Off-Ramp to S Main St
12:00 AM	68.0	69.0	68.0	66.0	66.0	65.0	66.0	67.0	66.0	67.0	67.0	67.0	66.0	64.0	65.0	64.0	47.0
12:15 AM	62.0	63.0	63.0	62.0	62.0	62.0	62.0	63.0	63.0	62.0	62.0	62.0	61.0	61.0	61.0	61.0	46.0
12:30 AM	64.0	63.0	62.0	62.0	62.0	62.0	63.0	64.0	64.0	62.0	62.0	62.0	62.0	62.0	63.0	62.0	46.0
12:45 AM	69.0	69.0	68.0	67.0	66.0	67.0	68.0	68.0	67.0	68.0	67.0	67.0	67.0	66.0	66.0	65.0	48.0
1:00 AM	67.0	67.0	66.0	65.0	65.0	65.0	66.0	68.0	67.0	67.0	67.0	67.0	66.0	65.0	65.0	65.0	50.0
1:15 AM	68.0	69.0	68.0	66.0	66.0	66.0	66.0	68.0	67.0	67.0	67.0	67.0	66.0	65.0	65.0	64.0	50.0
1:30 AM	68.0	69.0	68.0	66.0	66.0	65.0	66.0	68.0	66.0	68.0	67.0	68.0	67.0	67.0	67.0	64.0	50.0
1:45 AM	68.0	69.0	68.0	66.0	66.0	66.0	67.0	68.0	67.0	67.0	67.0	67.0	67.0	66.0	65.0	64.0	49.0
2:00 AM	68.0	68.0	67.0	66.0	65.0	65.0	66.0	67.0	66.0	67.0	67.0	67.0	67.0	66.0	64.0	64.0	49.0
2:15 AM	69.0	69.0	68.0	66.0	66.0	66.0	67.0	68.0	67.0	68.0	68.0	68.0	67.0	66.0	67.0	63.0	51.0
2:30 AM	68.0	68.0	68.0	66.0	66.0	65.0	67.0	68.0	67.0	67.0	67.0	67.0	67.0	66.0	66.0	65.0	50.0
2:45 AM	68.0	68.0	67.0	66.0	66.0	65.0	66.0	67.0	65.0	67.0	67.0	66.0	66.0	66.0	66.0	65.0	49.0
3:00 AM	68.0	68.0	67.0	67.0	66.0	66.0	67.0	68.0	67.0	67.0	67.0	67.0	67.0	66.0	68.0	66.0	49.0
3:15 AM	67.0	68.0	67.0	65.0	65.0	65.0	67.0	68.0	68.0	67.0	67.0	67.0	66.0	66.0	67.0	66.0	48.0
3:30 AM	68.0	68.0	67.0	66.0	66.0	65.0	67.0	67.0	66.0	66.0	66.0	67.0	66.0	66.0	65.0	65.0	49.0
3:45 AM	67.0	67.0	67.0	65.0	65.0	65.0	66.0	66.0	65.0	65.0	65.0	65.0	65.0	66.0	66.0	64.0	48.0
4:00 AM	66.0	66.0	65.0	63.0	63.0	64.0	64.0	66.0	66.0	66.0	65.0	66.0	65.0	65.0	66.0	64.0	47.0
4:15 AM	67.0	68.0	66.0	66.0	64.0	64.0	66.0	66.0	66.0	66.0	66.0	66.0	65.0	66.0	66.0	64.0	47.0
4:30 AM	69.0	68.0	68.0	68.0	67.0	66.0	67.0	69.0	68.0	69.0	69.0	68.0	67.0	67.0	68.0	68.0	46.0
4:45 AM	69.0	69.0	69.0	68.0	67.0	68.0	69.0	70.0	70.0	69.0	69.0	69.0	69.0	68.0	70.0	70.0	47.0
5:00 AM	70.0	69.0	69.0	69.0	68.0	70.0	69.0	71.0	72.0	71.0	70.0	69.0	69.0	69.0	71.0	71.0	48.0
5:15 AM	68.0	67.0	66.0	65.0	64.0	66.0	67.0	67.0	67.0	67.0	67.0	68.0	68.0	68.0	68.0	66.0	49.0
5:30 AM	68.0	68.0	67.0	65.0	65.0	65.0	68.0	69.0	68.0	67.0	67.0	67.0	67.0	66.0	68.0	69.0	48.0
5:45 AM	70.0	68.0	68.0	67.0	67.0	67.0	69.0	70.0	72.0	70.0	69.0	69.0	69.0	69.0	69.0	68.0	51.0
6:00 AM	69.0	68.0	68.0	67.0	67.0	68.0	69.0	69.0	70.0	70.0	68.0	68.0	69.0	68.0	71.0	69.0	52.0
6:15 AM	70.0	68.0	69.0	68.0	67.0	67.0	69.0	70.0	71.0	69.0	69.0	69.0	70.0	69.0	70.0	71.0	52.0
6:30 AM	69.0	66.0	67.0	66.0	66.0	66.0	67.0	69.0	70.0	69.0	67.0	67.0	68.0	68.0	70.0	70.0	51.0
6:45 AM	68.0	66.0	66.0	65.0	65.0	64.0	66.0	67.0	67.0	68.0	66.0	66.0	66.0	66.0	69.0	69.0	49.0
7:00 AM	68.0	66.0	68.0	67.0	67.0	67.0	66.0	68.0	69.0	69.0	68.0	68.0	68.0	68.0	69.0	68.0	47.0
7:15 AM	67.0	63.0	65.0	64.0	63.0	63.0	63.0	64.0	66.0	66.0	65.0	64.0	66.0	65.0	68.0	69.0	45.0
7:30 AM	67.0	59.0	61.0	59.0	58.0	55.0	56.0	59.0	63.0	63.0	61.0	59.0	61.0	62.0	65.0	67.0	43.0
7:45 AM	49.0	45.0	41.0	37.0	38.0	36.0	39.0	52.0	59.0	59.0	56.0	54.0	58.0	60.0	64.0	65.0	41.0
8:00 AM	43.0	38.0	33.0	37.0	37.0	36.0	41.0	51.0	63.0	63.0	61.0	60.0	61.0	62.0	64.0	66.0	38.0
8:15 AM	40.0	34.0	34.0	34.0	34.0	38.0	44.0	57.0	62.0	63.0	62.0	60.0	62.0	60.0	65.0	66.0	40.0
8:30 AM	36.0	30.0	35.0	34.0	30.0	30.0	35.0	40.0	60.0	61.0	60.0	59.0	59.0	62.0	65.0	67.0	41.0
8:45 AM	32.0	28.0	30.0	30.0	29.0	28.0	33.0	46.0	54.0	60.0	60.0	62.0	65.0	64.0	66.0	66.0	43.0
9:00 AM	38.0	36.0	35.0	34.0	32.0	32.0	35.0	49.0	55.0	55.0	53.0	60.0	61.0	63.0	65.0	64.0	43.0
9:15 AM	62.0	46.0	52.0	53.0	48.0	44.0	41.0	48.0	56.0	53.0	55.0	60.0	60.0	61.0	63.0	66.0	43.0
9:30 AM	58.0	56.0	56.0	56.0	55.0	52.0	42.0	52.0	61.0	64.0	64.0	65.0	64.0	64.0	66.0	66.0	42.0
9:45 AM	66.0	64.0	63.0	63.0	64.0	63.0	62.0	64.0	66.0	63.0	63.0	65.0	65.0	65.0	67.0	66.0	43.0
10:00 AM	69.0	65.0	65.0	67.0	65.0	67.0	67.0	68.0	68.0	66.0	67.0	65.0	67.0	65.0	67.0	68.0	42.0
10:15 AM	69.0	66.0	65.0	66.0	66.0	65.0	65.0	67.0	68.0	66.0	66.0	65.0	66.0	65.0	67.0	66.0	41.0
10:30 AM	66.0	65.0	66.0	67.0	66.0	65.0	65.0	68.0	67.0	66.0	66.0	65.0	65.0	65.0	67.0	66.0	42.0
10:45 AM	68.0	68.0	68.0	69.0	69.0	68.0	67.0	69.0	69.0	68.0	69.0	67.0	68.0	68.0	68.0	70.0	44.0
11:00 AM	69.0	67.0	69.0	69.0	68.0	68.0	68.0	67.0	68.0	67.0	67.0	67.0	68.0	68.0	69.0	70.0	42.0
11:15 AM	68.0	67.0	66.0	68.0	67.0	67.0	68.0	67.0	68.0	68.0	67.0	67.0	68.0	67.0	68.0	68.0	43.0
11:30 AM	70.0	66.0	68.0	69.0	66.0	67.0	66.0	68.0	68.0	68.0	68.0	67.0	67.0	67.0	69.0	68.0	42.0
11:45 AM	68.0	65.0	65.0	66.0	65.0	67.0	64.0	67.0	68.0	66.0	67.0	66.0	67.0	68.0	68.0	68.0	44.0
12:00 PM	69.0	67.0	67.0	67.0	66.0	66.0	66.0	68.0	70.0	67.0	68.0	68.0	68.0	68.0	70.0	69.0	43.0
12:15 PM	67.0	66.0	66.0	68.0	67.0	66.0	66.0	67.0	68.0	67.0	68.0	67.0	66.0	66.0	68.0	69.0	42.0
12:30 PM	70.0	69.0	69.0	70.0	68.0	69.0	68.0	69.0	70.0	68.0	69.0	68.0	68.0	67.0	69.0	69.0	43.0
12:45 PM	71.0	68.0	68.0	70.0	69.0	69.0	68.0	69.0	70.0	69.0	70.0	69.0	70.0	70.0	70.0	70.0	43.0
1:00 PM	69.0	67.0	67.0	67.0	66.0	66.0	66.0	68.0	68.0	67.0	67.0	67.0	66.0	67.0	68.0	68.0	43.0
1:15 PM	70.0	68.0	69.0	69.0	66.0	67.0	66.0	67.0	69.0	68.0	68.0	67.0	67.0	67.0	69.0	69.0	42.0
1:30 PM	70.0	65.0	66.0	68.0	65.0	64.0	65.0	67.0	68.0	67.0	67.0	67.0	65.0	64.0	67.0	68.0	41.0
1:45 PM	72.0	65.0	65.0	66.0	65.0	66.0	64.0	66.0	66.0	67.0	67.0	66.0	65.0	65.0	67.0	68.0	43.0
2:00 PM	70.0	67.0	66.0	65.0	64.0	64.0	62.0	64.0	67.0	66.0	66.0	66.0	66.0	66.0	67.0	68.0	43.0
2:15 PM	65.0	61.0	60.0	57.0	59.0	57.0	55.0	61.0	64.0	64.0	63.0	62.0	61.0	63.0	66.0	66.0	42.0
2:30 PM	57.0	45.0	45.0	60.0	55.0	58.0	54.0	58.0	64.0	62.0	61.0	61.0	60.0	61.0	63.0	62.0	38.0
2:45 PM	55.0	43.0	46.0	49.0	47.0	49.0	48.0	54.0	63.0	63.0	62.0	62.0	62.0	61.0	64.0	62.0	36.0
3:00 PM	61.0	50.0	46.0	54.0	54.0	42.0	42.0	55.0	63.0	63.0	61.0	59.0	56.0	58.0	60.0	57.0	43.0
3:15 PM	32.0	31.0	36.0	35.0	34.0	33.0	37.0	51.0	63.0	64.0	64.0	63.0	61.0	60.0	58.0	46.0	36.0
3:30 PM	27.0	28.0	28.0	28.0	28.0	28.0	32.0	48.0	60.0	62.0	61.0	59.0	57.0	57.0	51.0	26.0	35.0
3:45 PM	24.0	25.0	25.0	24.0	25.0	25.0	30.0	47.0	61.0	61.0	60.0	59.0	56.0	52.0	31.0	21.0	38.0
4:00 PM	26.0	27.0	25.0	25.0	25.0	26.0	32.0	50.0	59.0	58.0	56.0	52.0	42.0	39.0	23.0	18.0	35.0
4:15 PM	26.0	30.0	30.0	30.0	31.0	31.0	33.0	46.0	48.0	45.0	36.0	36.0	33.0	30.0	21.0	20.0	36.0
4:30 PM	39.0	36.0	29.0	27.0	28.0	28.0	28.0	35.0	39.0	36.0	29.0	30.0	31.0	28.0	22.0	19.0	35.0
4:45 PM	37.0	38.0	43.0	38.0	33.0	28.0	27.0	33.0	35.0	36.0	29.0	30.0	29.0	28.0	19.0	17.0	32.0
5:00 PM	60.0	44.0	27.0	26.0	26.0	26.0	27.0	34.0	35.0	32.0	28.0	32.0	33.0	28.0	21.0	20.0	32.0
5:15 PM	47.0	41.0	36.0	31.0	30.0	27.0	27.0	33.0	37.0	32.0	27.0	27.0	28.0	24.0	17.0	15.0	32.0
5:30 PM	38.0	26.0	18.0	18.0	19.0	20.0	23.0	28.0	33.0	29.0	27.0	28.0	28.0	25.0	18.0	15.0	33.0
5:45 PM	46.0	35.0	30.0	26.0	26.0	24.0	25.0	30.0	32.0	32.0	29.0	29.0	27.0	23.0	17.0	16.0	32.0
6:00 PM	60.0	55.0	51.0	40.0	36.0	29.0	24.0	32.0	31.0	34.0	28.0	31.0	31.0	30.0	21.0	19.0	34.0
6:15 PM	63.0	58.0	56.0	39.0	35.0	32.0	30.0	33.0	32.0	29.0	29.0	29.0	30.0	32.0	21.0	20.0	36.0
6:30 PM	63.0	57.0	46.0	38.0	35.0	37.0	42.0	44.0	48.0	49.0	48.0	52.0	49.0	45.0	29.0	26.0	36.0
6:45 PM	69.0	64.0	67.0	65.0	63.0	64.0	65.0	67.0	68.0	63.0	62.0	62.0	63.0	62.0	33.0	29.0	38.0
7:00 PM	68.0	64.0	65.0	65.0	65.0	66.0	67.0	65.0	66.0	63.0	63.0	62.0	63.0	65.0	64.0	60.0	39.0
7:15 PM	68.0	66.0	67.0	65.0	65.0	65.0	67.0	67.0	68.0	66.0	64.0	64.0	65.0	65.0	67.0	66.0	41.0
7:30 PM	68.0	66.0	67.0	66.0	65.0	66.0	66.0	70.0	69.0	68.0	64.0	65.0	65.0	67.0	67.0	67.0	44.0
7:45 PM	68.0	66.0	68.0	67.0	66.0	66.0	65.0	67.0	69.0	67.0	67.0	65.0	67.0	66.0	67.0	67.0	45.0
8:00 PM	70.0	68.0	69.0	69.0	69.0	68.0	69.0	69.0	68.0	67.0	67.0	65.0	67.0	67.0	67.0	69.0	45.0
8:15 PM	71.0	69.0	71.0	71.0	70.0	71.0	71.0	71.0	72.0	71.0	70.0	70.0	70.0	69.0	70.0	71.0	46.0
8:30 PM	70.0	70.0	71.0	70.0	70.0	70.0	71.0	73.0	72.0	72.0	70.0	69.0	68.0	70.0	70.0	69.0	46.0
8:45 PM	70.0	68.0	68.0	68.0	67.0	66.0	67.0	70.0	71.0	70.0	69.0	66.0	68.0	66.0	66.0	69.0	46.0
9:00 PM	71.0	70.0	69.0	69.0	67.0	68.0	70.0	71.0	72.0	70.0	69.0	68.0	69.0	67.0	67.0	69.0	49.0
9:15 PM	73.0	70.0	70.0	69.0	67.0	69.0	71.0	72.0	72.0	70.0	70.0	67.0	68.0	68.0	69.0	68.0	48.0
9:30 PM	72.0	70.0	70.0	71.0	70.0	72.0	72.0	72.0	72.0	72.0	70.0	69.0	69.0	69.0	70.0	71.0	51.0
9:45 PM	69.0	70.0	69.0	68.0	67.0	68.0	69.0	70.0	69.0	70.0	69.0	68.0	67.0	67.0	68.0	68.0	46.0
10:00 PM	70.0	69.0	69.0	68.0	68.0	68.0	68.0	69.0	70.0	70.0	69.0	67.0	67.0	68.0	69.0	69.0	48.0
10:15 PM	70.0	70.0	69.0	68.0	67.0	68.0	70.0	69.0	69.0	69.0	69.0	68.0	67.0	67.0	68.0	65.0	50.0
10:30 PM	68.0	69.0	68.0	67.0	67.0	66.0	68.0	68.0	66.0	67.0	67.0	67.0	66.0	66.0	65.0	63.0	51.0
10:45 PM	68.0	69.0	68.0	67.0	66.0	65.0	67.0	68.0	67.0	67.0	67.0	67.0	66.0	66.0	66.0	65.0	50.0
11:00 PM	67.5	69.0	68.0	66.0	66.0	66.0	68.0	68.0	66.0	67.0	67.0	67.0	67.0	66.0	66.0	64.0	48.0
11:15 PM	68.0	68.5	67.5	66.0	65.0	65.0	66.0	67.0	67.0	68.0	67.0	67.0	66.0	66.0	67.0	64.0	46.0
11:30 PM	68.0	69.0	68.0	66.0	66.0	66.0	67.0	68.0	66.0	68.0	67.0	67.0	66.0	66.0	66.0	64.0	45.0
11:45 PM	69.0	69.0	68.0	66.0	66.0	65.0	67.0	68.0	66.0	68.0	67.0	67.0	67.0	66.0	68.0	67.0	48.0

Green	Greater than 55 mph
Yellow	45 to 55 mph
Orange	35 to 45 mph
Red	Less than 35 mph

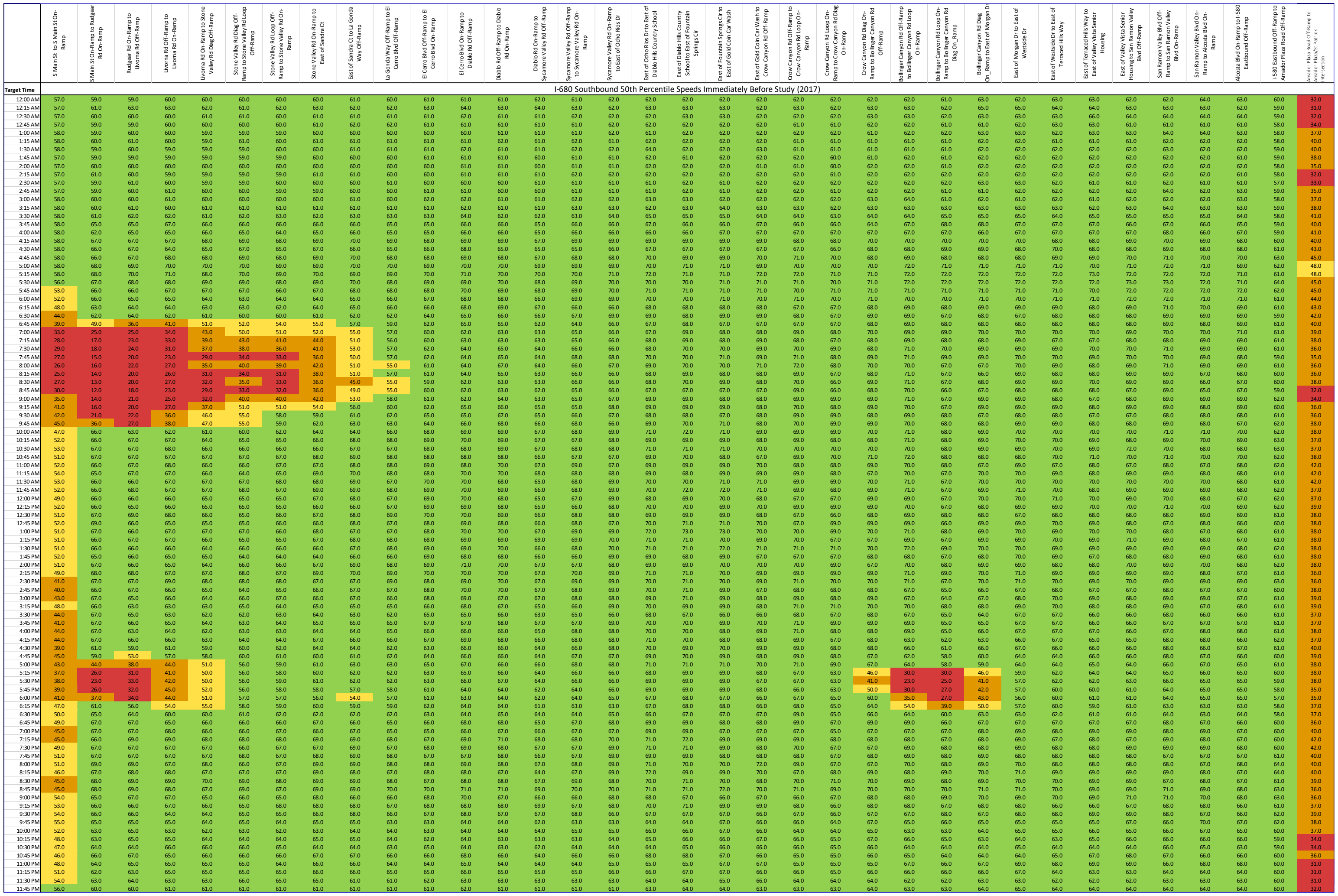
Figure 40: Speed Contours, I-680 Study Corridor Southbound, Before Study (2014)

I-680 Southbound 50th Percentile Speeds Before Study (2014)

Target Time	S Main St to S Main St On-Ramp	S Main St On-Ramp to Rudgear Rd On-Ramp	Rudgear Rd On-Ramp to Livorna Rd Off-Ramp	Livorna Rd Off-Ramp to Livorna Rd On-Ramp	Livorna Rd On-Ramp to Stone Valley Rd Diag Off-Ramp	Stone Valley Rd Diag Off-Ramp to Stone Valley Rd Loop Off-Ramp	Stone Valley Rd Loop Off-Ramp to Stone Valley Rd On-Ramp	Stone Valley Rd On-Ramp to East of Sandra Ct	East of Sandra Ct to La Gonda Way Off-Ramp	La Gonda Way Off-Ramp to El Cerro Blvd Off-Ramp	El Cerro Blvd Off-Ramp to El Cerro Blvd On-Ramp	El Cerro Blvd On-Ramp to Diablo Rd Off-Ramp	Diablo Rd Off-Ramp to Diablo Rd On-Ramp	Diablo Rd On-Ramp to Sycamore Valley Rd Off-Ramp	Sycamore Valley Rd Off-Ramp to Sycamore Valley Rd On-Ramp	Sycamore Valley Rd On-Ramp to East of Ocho Rios Dr	East of Ocho Rios Dr to East of Diablo Hills Country School	East of Diablo Hills Country School to East of Fountain Springs Cir	East of Fountain Springs Cir to East of Gold Coin Car Wash	East of Gold Coin Car Wash to Crow Canyon Rd Off-Ramp	Crow Canyon Rd Off-Ramp to Crow Canyon Rd Loop On-Ramp	Crow Canyon Rd Loop On-Ramp to Crow Canyon Rd Diag On-Ramp	Crow Canyon Rd Diag On-Ramp to Bollinger Canyon Rd Off-Ramp	Bollinger Canyon Rd Off-Ramp to Bollinger Canyon Rd Loop On-Ramp	Bollinger Canyon Rd Loop On-Ramp to Bollinger Canyon Rd Diag On_Ramp	Bollinger Canyon Rd Diag On_Ramp to East of Morgan Dr	East of Morgan Dr to East of Westside Dr	East of Westside Dr to East of Terraced Hills Way	East of Terraced Hills Way to East of Valley Vista Senior Housing	East of Valley Vista Senior Housing to San Ramon Valley Blvd Off-Ramp	San Ramon Valley Blvd Off-Ramp to San Ramon Valley Blvd On-Ramp	San Ramon Valley Blvd On-Ramp to Alcosta Blvd On-Ramp	Alcosta Blvd On-Ramp to I-580 Eastbound Off-Ramp	I-580 Eastbound Off-Ramp to Amador Plaza Road Off-Ramp	Amador Plaza Road Off-Ramp to Amador Plaza/St Patrick Intersection
12:00 AM	41.0	67.0	65.0	65.0	65.0	66.0	66.0	65.0	66.0	67.0	66.0	66.0	68.0	67.0	68.0	67.0	66.0	65.0	65.0	66.0	66.0	66.0	66.0	67.0	67.0	67.0	66.0	67.0	68.0	67.0	67.0	67.0	68.0	62.0	43.0
12:15 AM	41.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	66.0	65.0	65.0	66.0	65.0	67.0	65.0	65.0	66.0	65.0	66.0	66.0	66.0	66.0	66.0	67.0	68.0	67.0	67.0	67.0	67.0	67.0	67.0	66.0	66.0	62.0	43.0
12:30 AM	41.0	66.0	66.0	65.0	65.0	65.0	66.0	65.0	66.0	66.0	66.0	66.0	67.0	68.0	67.0	66.0	66.0	65.0	65.0	66.0	66.0	66.0	66.0	67.0	66.0	67.0	66.0	67.0	67.0	67.0	66.0	67.0	67.0	62.0	43.0
12:45 AM	41.0	67.0	66.0	64.0	65.0	65.0	66.0	65.0	66.0	66.0	66.0	67.0	68.0	68.0	67.0	67.0	65.0	65.0	64.0	65.0	66.0	66.0	66.0	66.0	67.0	66.0	65.0	66.0	67.0	66.0	66.0	67.0	68.0	62.0	43.0
1:00 AM	41.0	67.0	66.0	64.0	65.0	65.0	66.0	65.0	66.0	66.0	66.0	67.0	68.0	68.0	67.0	67.0	65.0	65.0	64.0	65.0	65.0	65.0	65.0	66.0	66.0	66.0	64.0	66.0	67.0	66.0	66.0	67.0	68.0	62.0	43.0
1:15 AM	41.0	66.0	66.0	64.0	65.0	65.0	66.0	65.0	66.0	66.0	65.0	66.0	68.0	68.0	67.0	67.0	65.0	65.0	64.0	65.0	65.0	65.0	65.0	66.0	66.0	66.0	65.0	66.0	67.0	66.0	66.0	67.0	68.0	62.0	43.0
1:30 AM	41.0	67.0	66.0	64.0	65.0	65.0	66.0	65.0	66.0	66.0	65.0	66.0	68.0	69.0	67.0	67.0	65.0	65.0	64.0	65.0	65.0	65.0	65.0	66.0	66.0	66.0	64.0	65.0	66.0	66.0	66.0	66.0	67.0	62.0	43.0
1:45 AM	41.0	67.0	65.0	64.0	65.0	65.0	65.0	64.0	66.0	66.0	65.0	66.0	67.0	67.0	67.0	67.0	66.0	65.0	64.0	65.0	65.0	65.0	65.0	66.0	66.0	67.0	65.0	66.0	67.0	67.0	66.0	68.0	68.0	62.0	43.0
2:00 AM	41.0	67.0	66.0	64.0	65.0	65.0	66.0	65.0	66.0	66.0	66.0	66.0	68.0	69.0	67.0	67.0	66.0	65.0	64.0	65.0	65.0	65.0	65.0	66.0	66.0	66.0	64.0	65.0	66.0	66.0	66.0	66.0	66.0	62.0	43.0
2:15 AM	41.0	67.0	66.0	64.0	65.0	65.0	66.0	66.0	67.0	66.0	65.0	67.0	68.0	69.0	67.0	67.0	66.0	65.0	64.0	65.0	65.0	65.0	65.0	66.0	66.0	67.0	66.0	66.0	67.0	67.0	65.0	67.0	68.0	62.0	43.0
2:30 AM	41.0	67.0	66.0	64.0	65.0	65.0	66.0	65.0	66.0	66.0	65.0	66.0	67.0	67.0	66.0	67.0	66.0	65.0	64.0	65.0	65.0	65.0	65.0	66.0	67.0	66.0	64.0	66.0	67.0	67.0	66.0	67.0	68.0	62.0	43.0
2:45 AM	41.0	67.0	67.0	64.0	65.0	65.0	66.0	65.0	66.0	66.0	66.0	66.0	68.0	69.0	67.0	67.0	66.0	65.0	64.0	65.0	65.0	65.0	65.0	66.0	66.0	66.0	65.0	66.0	67.0	66.0	66.0	66.0	68.0	62.0	43.0
3:00 AM	41.0	67.0	66.0	65.0	65.0	66.0	66.0	65.0	67.0	66.0	65.0	66.0	67.0	68.0	67.0	67.0	65.0	65.0	64.0	65.0	65.0	65.0	65.0	66.0	66.0	66.0	65.0	66.0	66.0	66.0	66.0	66.0	68.0	62.0	43.0
3:15 AM	41.0	67.0	66.0	65.0	65.0	66.0	67.0	66.0	67.0	66.0	66.0	66.0	67.0	69.0	67.0	67.0	66.0	65.0	65.0	66.0	66.0	66.0	66.0	67.0	66.0	67.0	65.0	67.0	67.0	66.0	66.0	67.0	68.0	62.0	43.0
3:30 AM	41.0	67.0	66.0	65.0	65.0	66.0	66.0	65.0	67.0	66.0	65.0	66.0	67.0	69.0	67.0	67.0	66.0	65.0	65.0	65.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	67.0	67.0	66.0	66.0	67.0	68.0	62.0	43.0
3:45 AM	41.0	67.0	66.0	65.0	65.0	66.0	66.0	65.0	67.0	67.0	66.0	67.0	68.0	69.0	67.0	67.0	66.0	65.0	65.0	65.0	66.0	66.0	66.0	66.0	66.0	66.0	65.0	66.0	67.0	67.0	66.0	67.0	68.0	62.0	43.0
4:00 AM	41.0	66.0	66.0	64.0	65.0	65.0	65.0	65.0	66.0	66.0	65.0	66.0	67.0	67.0	66.0	67.0	66.0	66.0	65.0	65.0	65.0	66.0	65.0	66.0	66.0	66.0	65.0	66.0	67.0	67.0	66.0	66.0	68.0	62.0	43.0
4:15 AM	53.0	67.0	67.0	66.0	66.0	67.0	66.0	65.0	67.0	67.0	66.0	67.0	68.0	67.0	68.0	67.0	66.0	66.0	67.0	66.0	66.0	66.0	66.0	67.0	68.0	66.0	66.0	67.0	67.0	66.0	66.0	67.0	68.0	64.0	41.0
4:30 AM	53.0	69.0	68.0	68.0	68.0	69.0	69.0	68.0	69.0	69.0	69.0	68.0	70.0	69.0	70.0	68.0	67.0	68.0	69.0	69.0	68.0	68.0	67.0	67.0	68.0	68.0	67.0	68.0	68.0	68.0	68.0	68.0	68.0	64.0	41.0
4:45 AM	53.0	67.0	68.0	67.0	67.0	68.0	68.0	68.0	69.0	68.0	68.0	68.0	68.0	68.0	68.0	69.0	68.0	69.0	69.0	69.0	69.0	69.0	68.0	69.0	70.0	69.0	68.0	69.0	69.0	70.0	70.0	68.0	68.0	64.0	41.0
5:00 AM	45.0	69.0	69.0	70.0	69.0	69.0	69.0	70.0	70.0	69.0	69.0	70.0	69.0	69.0	70.0	69.0	70.0	70.0	70.0	69.0	70.0	68.0	69.0	71.0	70.0	70.0	69.0	70.0	70.0	70.0	70.0	69.0	69.0	64.0	34.0
5:15 AM	44.0	68.0	69.0	69.0	70.0	70.0	69.0	70.0	70.0	69.0	69.0	71.0	71.0	70.0	71.0	70.0	71.0	70.0	71.0	71.0	72.0	71.0	72.0	71.0	71.0	73.0	72.0	71.0	71.0	72.0	72.0	72.0	70.0	63.0	33.0
5:30 AM	45.0	68.0	69.0	68.0	68.0	68.0	68.0	68.0	70.0	68.0	69.0	69.0	69.0	70.0	69.0	69.0	69.0	70.0	70.0	71.0	71.0	70.0	71.0	73.0	72.0	72.0	72.0	72.0	71.0	72.0	72.0	71.0	71.0	63.0	31.0
5:45 AM	44.0	67.0	68.0	67.0	68.0	67.0	67.0	68.0	68.0	68.0	67.0	68.0	69.0	68.0	69.0	69.0	70.0	69.0	70.0	70.0	70.0	70.0	69.0	70.0	72.0	70.0	70.0	70.0	70.0	71.0	71.0	71.0	71.0	62.0	31.0
6:00 AM	41.0	68.0	68.0	68.0	67.0	68.0	67.0	68.0	67.0	67.0	67.0	69.0	68.0	67.0	68.0	67.0	69.0	69.0	69.0	69.0	70.0	68.0	70.0	71.0	70.0	69.0	69.0	70.0	69.0	70.0	71.0	70.0	70.0	62.0	31.0
6:15 AM	38.0	66.0	64.0	64.0	64.0	65.0	64.0	64.0	65.0	65.0	66.0	67.0	66.0	66.0	66.0	66.0	68.0	69.0	68.0	69.0	70.0	69.0	68.0	70.0	70.0	69.0	68.0	69.0	68.0	69.0	69.0	68.0	68.0	62.0	30.0
6:30 AM	37.0	64.0	63.0	63.0	63.0	63.0	63.0	63.0	64.0	64.0	65.0	66.0	66.0	64.0	65.0	66.0	67.0	68.0	67.0	67.0	68.0	67.0	69.0	69.0	68.0	68.0	68.0	69.0	67.0	68.0	69.0	68.0	67.0	62.0	31.0
6:45 AM	37.0	62.0	59.0	57.0	59.0	60.0	59.0	59.0	61.0	63.0	64.0	66.0	66.0	64.0	64.0	65.0	67.0	68.0	67.0	67.0	68.0	67.0	69.0	69.0	67.0	66.0	68.0	67.0	66.0	67.0	68.0	67.0	66.0	61.0	32.0
7:00 AM	35.0	48.0	37.0	45.0	50.0	55.0	54.0	54.0	58.0	61.0	63.0	65.0	65.0	63.0	65.0	65.0	67.0	68.0	68.0	67.0	69.0	68.0	69.0	71.0	68.0	68.0	68.0	68.0	67.0	68.0	67.0	68.0	67.0	62.0	33.0
7:15 AM	32.0	24.0	26.0	34.0	41.0	44.0	43.0	44.0	53.0	59.0	61.0	64.0	64.0	62.0	63.0	64.0	67.0	68.0	67.0	67.0	68.0	68.0	68.0	70.0	68.0	68.0	69.0	69.0	67.0	69.0	69.0	68.0	67.0	61.0	33.0
7:30 AM	28.0	20.0	23.0	29.0	34.0	38.0	37.0	42.0	53.0	59.0	62.0	64.0	64.0	63.0	64.0	65.0	67.0	68.0	66.0	67.0	68.0	67.0	68.0	69.0	67.0	68.0	67.0	68.0	67.0	68.0	68.0	67.0	67.0	62.0	34.0
7:45 AM	28.0	20.0	24.0	32.0	39.0	42.0	38.0	42.0	50.0	57.0	61.0	63.0	65.0	62.0	64.0	65.0	66.0	68.0	66.0	66.0	68.0	68.0	67.0	69.0	67.0	66.0	67.0	66.0	66.0	67.0	67.0	66.0	67.0	61.0	33.0
8:00 AM	28.0	22.0	23.0	27.0	34.0	38.0	37.0	39.0	50.0	57.0	61.0	62.0	64.0	62.0	65.0	65.0	67.0	68.0	67.0	67.0	68.0	68.0	68.0	69.0	67.0	68.0	67.0	68.0	68.0	68.0	68.0	67.0	67.0	61.0	32.0
8:15 AM	27.0	19.0	20.0	26.0	32.0	35.0	35.0	39.0	49.0	59.0	63.0	64.0	65.0	64.0	65.0	65.0	67.0	68.0	67.0	67.0	69.0	69.0	69.0	70.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	66.0	66.0	62.0	34.0
8:30 AM	30.0	16.0	23.0	28.0	35.0	37.0	38.0	42.0	53.0	60.0	62.0	64.0	64.0	62.0	64.0	64.0	67.0	68.0	67.0	67.0	67.0	69.0	68.0	69.0	66.0	67.0	67.0	68.0	68.0	68.0	67.0	67.0	67.0	61.0	34.0
8:45 AM	30.0	17.0	24.0	30.0	35.0	39.0	37.0	42.0	53.0	60.0	61.0	63.0	64.0	62.0	65.0	65.0	67.0	68.0	67.0	66.0	68.0	67.0	68.0	68.0	66.0	67.0	67.0	68.0	67.0	67.0	67.0	67.0	67.0	61.0	33.0
9:00 AM	32.0	24.0	27.0	32.0	37.0	43.0	43.0	45.0	55.0	60.0	63.0	65.0	65.0	64.0	66.0	65.0	67.0	67.0	67.0	66.0	68.0	67.0	68.0	69.0	66.0	68.0	67.0	68.0	66.0	67.0	68.0	67.0	67.0	61.0	32.0
9:15 AM	33.0	42.0	38.0	36.0	42.0	47.0	50.0	51.0	57.0	61.0	63.0	65.0	66.0	64.0	66.0	64.0	66.0	66.0	67.0	66.0	68.0	68.0	68.0	70.0	68.0	68.0	69.0	69.0	68.0	68.0	69.0	68.0	67.0	60.0	32.0
9:30 AM	34.0	62.0	55.0	48.0	54.0	56.0	58.0	61.0	63.0	65.0	66.0	67.0	68.0	65.0	67.0	66.0	68.0	69.0	69.0	68.0	70.0	68.0	70.0	71.0	68.0	68.0	70.0	69.0	68.0	67.0	69.0	68.0	67.0	61.0	32.0
9:45 AM	33.0	65.0	62.0	62.0	62.0	63.0	61.0	64.0	65.0	65.0	67.0	67.0	68.0	65.0	67.0	66.0	69.0	69.0	69.0	68.0	69.0	68.0	70.0	70.0	68.0	70.0	69.0	70.0	68.0	68.0	70.0	70.0	68.0	62.0	32.0
10:00 AM	37.0	65.0	65.0	65.0	65.0	65.0	65.0	66.0	67.0	68.0	67.0	68.0	69.0	66.0	68.0	67.0	69.0	69.0	69.0	68.0	69.0	69.0	68.0	70.0	68.0	69.0	70.0	69.0	68.0	69.0	68.0	68.0	67.0	61.0	33.0
10:15 AM	41.0	66.0	66.0	65.0	65.0	65.0	66.0	66.0	67.0	67.0	67.0	68.0	68.0	66.0	68.0	67.0	69.0	70.0	70.0	70.0	69.0	69.0	70.0	71.0	69.0	70.0	71.0	70.0	69.0	68.0	70.0	69.0	68.0	61.0	33.0
10:30 AM	43.0	67.0	66.0	66.0	65.0	65.0	65.0	67.0	68.0	68.0	68.0	69.0	68.0	68.0	69.0	68.0	70.0	69.0	69.0	69.0	69.0	69.0	70.0	71.0	69.0	69.0	70.0	70.0	69.0	70.0	71.0	70.0	68.0	61.0	32.0
10:45 AM	45.0	68.0	67.0	67.0	66.0	66.0	67.0	68.0	68.0	68.0	68.0	69.0	68.0	68.0	69.0	68.0	70.0	70.0	70.0	69.0	70.0	70.0	70.0	71.0	69.0	70.0	70.0	70.0	69.0	70.0	70.0	69.0	68.0	60.0	34.0
11:00 AM	41.0	68.0	67.0	66.0	66.0	67.0	67.0	68.0	67.0	68.0	68.0	68.0	69.0	67.0	69.0	67.0	70.0	69.0	69.0	69.0	70.0	69.0	70.0	70.0	69.0	70.0	70.0	70.0	69.0	69.0	70.0	69.0	69.0	60.0	34.0
11:15 AM	37.0	68.0	68.0	68.0	67.0	67.0	67.0	68.0	68.0	68.0	68.0	69.0	70.0	67.0	68.0	67.0	69.0	69.0	69.0	68.0	69.0	69.0	69.0	70.0	69.0	69.0	70.0	70.0	69.0	69.0	70.0	69.0	69.0	61.0	34.0
11:30 AM	42.0	67.0	66.0	67.0	66.0	66.0	66.0	68.0	69.0	68.0	68.0	69.0	68.0	67.0	68.0	67.0	69.0	69.0	69.0	68.0	69.0	69.0	69.0	71.0	68.0	69.0	70.0	70.0	69.0	68.0	70.0	70.0	69.0	62.0	34.0
11:45 AM	39.0	66.0	65.0	65.0	65.0	65.0	65.0	66.0	67.0	67.0	67.0	67.0	67.0	66.0	67.0	66.0	68.0	69.0	68.0	68.0	69.0	68.0	69.0	69.0	68.0	69.0	68.0	68.0	67.0	66.0	69.0	68.0	68.0	61.0	34.0
12:00 PM	37.0	67.0	67.0	66.0	66.0	67.0	66.0	67.0	67.0	68.0	69.0	69.0	69.0	66.0	68.0	67.0	70.0	70.0	69.0	68.0	68.0	68.0	69.0	70.0	67.0	68.0	68.0	68.0	67.0	67.0	69.0	69.0	67.0	61.0	34.0
12:15 PM	36.0	67.0	67.0	67.0	66.0	65.0	66.0	68.0	69.0	68.0	68.0	69.0	69.0	67.0	68.0	67.0	70.0	70.0	70.0	68.0	70.0	68.0	69.0	70.0	68.0	68.0	68.0	68.0	68.0	68.0	69.0	68.0	67.0	61.0	32.0
12:30 PM	41.0	66.0	66.0	66.0	65.0	66.0	65.0	66.0	66.0	66.0	67.0	68.0	67.0	66.0	67.0	66.0	68.0	68.0	67.0	67.0	68.0	68.0	69.0	69.0	68.0	69.0	70.0	69.0	69.0	69.0	69.0	69.0	69.0	61.0	31.0
12:45 PM	36.0	68.0	67.0	66.0	66.0	67.0	67.0	68.0	68.0	68.0	68.0	68.0	68.0	66.0	69.0	67.0	70.0	69.0	69.0	67.0	69.0	68.0	69.0	70.0	68.0	69.0	68.0	67.0	67.0	68.0	68.0	67.0	67.0	62.0	34.0
1:00 PM	37.0	67.0	67.0	67.0	67.0	66.0	66.0	68.0	68.0	68.0	69.0	70.0	69.0	67.0	69.0	67.0	69.0	70.0	69.0	68.0	71.0	70.0	70.0	71.0	68.0	69.0	70.0	69.0	68.0	69.0	68.0	68.0	67.0	60.0	31.0
1:15 PM	39.0	67.0	67.0	66.0	65.0	65.0	66.0	68.0	68.0	68.0	68.0	69.0	69.0	67.0	68.0	68.0	70.0	70.0	69.0	68.0	71.0	70.0	70.0	71.0	68.0	70.0	70.0	70.0	69.0	69.0	68.0	69.0	67.0	62.0	31.0
1:30 PM	40.0	68.0	67.0	67.0	66.0	66.0	67.0	67.0	68.0	68.0	69.0	69.0	69.0	68.0	69.0	68.0	70.0	71.0	70.0	70.0	70.0	69.0	70.0	71.0	69.0	70.0	70.0	71.0	70.0	69.0	70.0	69.0	68.0	62.0	31.0
1:45 PM	42.0	67.0	66.0	66.0	66.0	66.0	66.0	68.0	67.0	68.0	69.0	70.0	69.0	67.0	69.0	68.0	69.0	69.0	69.0	68.0	69.0	67.0	68.0	69.0	67.0	68.0	69.0	69.0	68.0	68.0	69.0	69.0	67.0	61.0	30.0
2:00 PM	40.0	67.0	66.0	65.0	65.0	66.0	66.0	67.0	69.0	68.0	68.0	67.0	68.0	66.0	68.0	67.0	69.0	69.0	70.0	69.0	69.0	67.0	68.0	69.0	68.0	68.0	69.0	68.0	68.0	67.0	68.0	68.0	68.0	61.0	29.0
2:15 PM	41.0	66.0	65.0	65.0	65.0	65.0	65.0	66.0	67.0	67.0	67.0	68.0	68.0	66.0	68.0	67.0	68.0	69.0	69.0	68.0	69.0	68.0	68.0	69.0	67.0	68.0	68.0	67.0	67.0	67.0	67.0	68.0	68.0	61.0	30.0
2:30 PM	42.0	66.0	65.0	65.0	65.0	65.0	65.0	66.0	67.0	66.0	67.0	67.0	68.0	66.0	67.0	66.0	67.0	68.0	69.0	67.0	68.0	68.0	69.0	69.0	67.0	68.0	67.0	67.0	67.0	67.0	67.0	67.0	67.0	61.0	33.0
2:45 PM	43.0	66.0	66.0	65.0	65.0	65.0	65.0	66.0	67.0	67.0	68.0	68.0	68.0	66.0	68.0	67.0	69.0	69.0	69.0	69.0	69.0	68.0	69.0	69.0	68.0	69.0	69.0	68.0	67.0	68.0	69.0	67.0	67.0	61.0	31.0
3:00 PM	41.0	66.0	67.0	66.0	66.0	66.0	66.0	66.0	67.0	66.0	67.0	68.0	68.0	66.0	67.0	66.0	69.0	69.0	69.0	69.0	68.0	69.0	66.0	68.0	64.0	67.0	69.0	68.0	67.0	68.0	69.0	69.0	68.0	62.0	33.0
3:15 PM	42.0	67.0	65.0	65.0	64.0	65.0	65.0	65.0	65.0	65.0	66.0	67.0	67.0	66.0	67.0	66.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	67.0	66.0	68.0	69.0	67.0	67.0	66.0	68.0	68.0	67.0	62.0	35.0
3:30 PM	40.0	66.0	65.0	64.0	64.0	65.0	65.0	65.0	65.0	66.0	67.0	68.0	68.0	66.0	67.0	66.0	69.0	70.0	69.0	69.0	69.0	70.0	70.0	67.0	66.0	69.0	69.0	68.0	68.0	68.0	68.0	68.0	68.0	61.0	35.0
3:45 PM	39.0	65.0	63.0	62.0	62.0	63.0	63.0	64.0	65.0	65.0	66.0	67.0	68.0	66.0	67.0	67.0	70.0	70.0	70.0	69.0	69.0	68.0	69.0	68.0	66.0	67.0	69.0	68.0	67.0	66.0	69.0	68.0	67.0	61.0	34.0
4:00 PM	40.0	65.0	63.0	63.0	62.0	63.0	63.0	63.0	65.0	65.0	66.0	67.0	68.0	66.0	67.0	66.0	69.0	69.0	69.0	69.0	70.0	68.0	69.0	67.0	65.0	67.0	69.0	69.0	67.0	67.0	68.0	69.0	68.0	61.0	35.0
4:15 PM	38.0	65.0	63.0	61.0	61.0	63.0	63.0	64.0	65.0	65.0	66.0	67.0	68.0	66.0	67.0	66.0	69.0	69.0	69.0	68.0	69.0	68.0	68.0	66.0	64.0	66.0	67.0	67.0	65.0	66.0	67.0	67.0	67.0	62.0	34.0
4:30 PM	39.0	63.0	57.0	54.0	59.0	62.0	64.0	63.0	63.0	65.0	65.0	66.0	66.0	65.0	66.0	66.0	69.0	70.0	69.0	69.0	70.0	68.0	68.0	67.0	66.0	66.0	68.0	67.0	65.0	66.0	68.0	68.0	67.0	62.0	35.0
4:45 PM	38.0	59.0	54.0	51.0	56.0	59.0	60.0	60.0	62.0	63.0	65.0	66.0	67.0	65.0	66.0	66.0	69.0	69.0	68.0	68.0	69.0	67.0	68.0	64.0	61.0	63.0	65.0	65.0	64.0	65.0	67.0	67.0	66.0	61.0	36.0
5:00 PM	36.0	51.0	37.0	44.0	54.0	58.0	58.0	59.0	61.0	63.0	64.0	66.0	67.0	65.0	67.0	65.0	68.0	67.0	67.0	67.0	69.0	67.0	67.0	66.0	61.0	60.0	63.0	66.0	65.0	65.0	67.0	67.0	67.0	60.0	34.0
5:15 PM	34.0	27.0	29.0	38.0	48.0	54.0	55.0	56.0	60.0	61.0	63.0	65.0	65.0	64.0	65.0	64.0	67.0	68.0	67.0	66.0	66.0	63.0	55.0	38.0	36.0	50.0	60.0	63.0	62.0	63.0	64.0	65.0	65.0	61.0	33.0
5:30 PM	32.0	21.0	28.0	38.0	50.0	56.0	57.0	57.0	59.0	61.0	62.0	64.0	65.0	64.0	66.0	64.0	67.0	67.0	66.0	65.0	64.0	59.0	46.0	28.0	31.0	46.0	58.0	60.0	62.0	63.0	65.0	65.0	64.0	59.0	33.0
5:45 PM	32.0	23.0	29.0	38.0	50.0	55.0	55.0	53.0	56.0	61.0	61.0	64.0	65.0	63.0	64.0	64.0	67.0	67.0	67.0	65.0	65.0	62.0	49.0	32.0	28.0	45.0	58.0	60.0	61.0	63.0	64.0	65.0	64.0	60.0	33.0
6:00 PM	34.0	34.0	30.0	39.0	49.0	55.0	56.0	56.0	59.0	61.0	63.0	65.0	65.0	64.0	65.0	64.0	68.0	67.0	67.0	66.0	67.0	65.0	61.0	48.0	43.0	53.0	58.0	62.0	61.0	62.0	64.0	65.0	65.0	60.0	35.0
6:15 PM	34.0	55.0	44.0	48.0	55.0	58.0	59.0	59.0	61.0	62.0	64.0	66.0	66.0	63.0	65.0	64.0	67.0	68.0	68.0	67.0	67.0	66.0	66.0	64.0	59.0	62.0	63.0	64.0	63.0	64.0	66.0	65.0	65.0	60.0	37.0
6:30 PM	33.0	62.0	61.0	61.0	62.0	63.0	64.0	63.0	64.0	63.0	63.0	66.0	66.0	64.0	65.0	65.0	68.0	68.0	67.0	67.0	68.0	67.0	67.0	66.0	63.0	66.0	67.0	67.0	66.0	66.0	67.0	68.0	66.0	60.0	37.0
6:45 PM	34.0	66.0	65.0	65.0	65.0	66.0	66.0	67.0	67.0	65.0	66.0	67.0	67.0	65.0	67.0	66.0	68.0	68.0	67.0	67.0	68.0	67.0	67.0	65.0	64.0	67.0	67.0	67.0	66.0	66.0	67.0	67.0	66.0	61.0	36.0
7:00 PM	32.0	66.0	66.0	65.0	66.0	66.0	66.0	67.0	67.0	66.0	66.0	67.0	67.0	67.0	68.0	67.0	69.0	69.0	69.0	69.0	69.0	69.0	69.0	71.0	69.0	69.0	70.0	70.0	69.0	69.0	70.0	70.0	68.0	61.0	31.0
7:15 PM	35.0	67.0	66.0	66.0	66.0	66.0	66.0	67.0	68.0	67.0	67.0	68.0	69.0	68.0	69.0	68.0	69.0	69.0	70.0	69.0	68.0	68.0	68.0	68.0	68.0	69.0	69.0	70.0	69.0	69.0	70.0	70.0	69.0	62.0	32.0
7:30 PM	35.0	68.0	66.0	65.0	65.0	66.0	65.0	67.0	67.0	66.0	66.0	67.0	68.0	68.0	68.0	68.0	69.0	68.0	69.0	68.0	69.0	68.0	68.0	70.0	68.0	69.0	70.0	69.0	69.0	69.0	70.0	70.0	69.0	62.0	31.0
7:45 PM	35.0	67.0	67.0	66.0	66.0	66.0	65.0	67.0	69.0	68.0	67.0	67.0	68.0	69.0	68.0	68.0	69.0	68.0	69.0	68.0	69.0	68.0	68.0	69.0	68.0	68.0	69.0	69.0	68.0	69.0	69.0	68.0	69.0	62.0	31.0
8:00 PM	36.0	68.0	67.0	67.0	66.0	67.0	67.0	68.0	69.0	67.0	68.0	68.0	69.0	68.0	69.0	68.0	69.0	68.0	69.0	68.0	69.0	68.0	68.0	70.0	69.0	69.0	70.0	70.0	70.0	70.0	71.0	70.0	69.0	62.0	31.0
8:15 PM	41.0	68.0	67.0	66.0	66.0	67.0	66.0	67.0	67.0	68.0	68.0	68.0	69.0	69.0	68.0	69.0	68.0	69.0	68.0	69.0	68.0	69.0	67.0	70.0	69.0	69.0	69.0	70.0	68.0	69.0	69.0	68.0	69.0	62.0	31.0
8:30 PM	36.0	68.0	68.0	67.0	66.0	67.0	67.0	68.0	67.0	67.0	67.0	67.0	68.0	68.0	68.0	67.0	68.0	68.0	67.0	67.0	67.0	68.0	68.0	68.0	68.0	68.0	68.0	69.0	68.0	69.0	70.0	69.0	68.0	62.0	31.0
8:45 PM	38.0	67.0	67.0	66.0	66.0	66.0	66.0	68.0	67.0	66.0	66.0	67.0	68.0	67.0	66.0	68.0	68.0	68.0	69.0	68.0	69.0	68.0	68.0	68.0	68.0	69.0	69.0	69.0	68.0	69.0	70.0	68.0	69.0	63.0	32.0
9:00 PM	40.0	66.0	66.0	67.0	67.0	67.0	67.0	67.0	68.0	66.0	66.0	66.0	68.0	68.0	67.0	66.0	66.0	66.0	66.0	67.0	67.0	68.0	68.0	68.0	67.0	68.0	68.0	67.0	69.0	69.0	69.0	68.0	68.0	63.0	32.0
9:15 PM	41.0	66.0	66.0	65.0	66.0	66.0	67.0	67.0	67.0	67.0	66.0	67.0	67.0	67.0	67.0	67.0	66.0	67.0	66.0	66.0	66.0	67.0	67.0	69.0	67.0	68.0	69.0	70.0	69.0	70.0	69.0	69.0	69.0	63.0	33.0
9:30 PM	43.0	66.0	65.0	65.0	66.0	65.0	65.0	65.0	66.0	66.0	65.0	66.0	67.0	67.0	67.0	67.0	66.0	66.0	66.0	67.0	67.0	67.0	67.0	67.0	66.0	66.0	67.0	67.0	67.0	67.0	67.0	67.0	67.0	62.0	34.0
9:45 PM	44.0	66.0	65.0	65.0	66.0	66.0	66.0	66.0	67.0	66.0	66.0	67.0	68.0	68.0	68.0	68.0	69.0	69.0	69.0	68.0	68.0	68.0	67.0	68.0	69.0	68.0	69.0	69.0	69.0	68.0	68.0	67.0	67.0	63.0	35.0
10:00 PM	41.0	66.0	66.0	66.0	66.0	66.0	67.0	65.0	66.0	67.0	67.0	66.0	68.0	67.0	67.0	67.0	67.0	67.0	67.0	67.0	66.0	67.0	66.0	67.0	67.0	67.0	67.0	67.0	66.0	67.0	67.0	67.0	67.0	62.0	43.0
10:15 PM	41.0	67.0	66.0	65.0	66.0	66.0	66.0	66.0	67.0	67.0	66.0	67.0	68.0	69.0	68.0	67.0	67.0	67.0	67.0	67.0	67.0	67.0	68.0	68.0	68.0	68.0	67.0	67.0	68.0	68.0	67.0	67.0	67.0	61.0	43.0
10:30 PM	41.0	67.0	65.0	65.0	66.0	67.0	67.0	66.0	66.0	67.0	67.0	66.0	67.0	68.0	67.0	67.0	66.0	66.0	66.0	67.0	67.0	67.0	66.0	67.0	67.0	67.0	67.0	67.0	68.0	68.0	67.0	67.0	68.0	62.0	43.0
10:45 PM	41.0	67.0	64.0	65.0	65.0	66.0	66.0	65.0	67.0	66.0	65.0	66.0	68.0	69.0	67.0	67.0	66.0	65.0	65.0	66.0	66.0	66.0	66.0	67.0	66.0	67.0	66.0	66.0	67.0	67.0	67.0	68.0	68.0	62.0	43.0
11:00 PM	41.0	67.0	66.0	65.0	66.0	66.0	66.0	66.0	67.0	67.0	66.0	67.0	68.0	69.0	67.0	67.0	66.0	66.0	65.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	67.0	67.0	67.0	67.0	67.0	68.0	68.0	62.0	43.0
11:15 PM	41.0	67.0	66.0	65.0	66.0	66.0	66.0	66.0	67.0	66.0	66.0	66.0	68.0	69.0	67.0	67.0	66.0	66.0	66.0	66.0	66.0	66.0	65.0	66.0	66.0	66.0	67.0	67.0	67.0	66.0	67.0	68.0	68.0	62.0	43.0
11:30 PM	41.0	66.0	66.0	65.0	65.0	65.0	66.0	65.0	67.0	66.0	66.0	67.0	68.0	69.0	68.0	67.0	66.0	66.0	64.0	66.0	66.0	66.0	65.0	66.0	67.0	67.0	66.0	68.0	68.0	67.0	67.0	68.0	69.0	62.0	43.0
11:45 PM	41.0	66.0	65.0	65.0	65.0	66.0	66.0	65.0	66.0	67.0	65.0	66.0	68.0	68.0	68.0	67.0	66.0	65.0	65.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	67.0	67.0	66.0	68.0	69.0	62.0	43.0

Green	Greater than 55 mph
Yellow	45 to 55 mph
Orange	35 to 45 mph
Red	Less than 35 mph

Figure 41: Speed Contours, I-680 Study Corridor Southbound, Supplemental Before Study (2017)



Green	Greater than 55 mph
Yellow	45 to 55 mph
Orange	35 to 45 mph
Red	Less than 35 mph

Figure 42: Speed Contours, I-680 Study Corridor Southbound, After Study (2018)

I-680 Southbound 50th Percentile Speeds After Study (2018)

Target Time	S Main St to S Main St On-Ramp	S Main St On-Ramp to Rudgear Rd On-Ramp	Rudgear Rd On-Ramp to Livorna Rd Off-Ramp	Livorna Rd Off-Ramp to Livorna Rd On-Ramp	Livorna Rd On-Ramp to Stone Valley Rd Diag Off-Ramp	Stone Valley Rd Diag Off-Ramp to Stone Valley Rd Loop Off-Ramp	Stone Valley Rd Loop Off-Ramp to Stone Valley Rd On-Ramp	Stone Valley Rd On-Ramp to East of Sandra Ct	East of Sandra Ct to La Gonda Way Off-Ramp	La Gonda Way Off-Ramp to El Cerro Blvd Off-Ramp	El Cerro Blvd Off-Ramp to El Cerro Blvd On-Ramp	El Cerro Blvd On-Ramp to Diablo Rd Off-Ramp	Diablo Rd Off-Ramp to Diablo Rd On-Ramp	Diablo Rd On-Ramp to Sycamore Valley Rd Off-Ramp	Sycamore Valley Rd Off-Ramp to Sycamore Valley Rd On-Ramp	Sycamore Valley Rd On-Ramp to East of Ocho Rios Dr
12:00 AM	28.0	68.0	65.0	65.0	66.0	66.0	66.0	65.0	67.0	66.0	66.0	67.0	68.0	68.0	69.0	69.0
12:15 AM	29.0	61.0	61.0	61.0	61.0	61.0	62.0	62.0	62.0	63.0	62.0	64.0	64.0	63.0	62.0	62.0
12:30 AM	30.0	63.0	62.0	62.0	62.0	63.0	63.0	62.0	62.0	63.0	63.0	63.0	63.0	63.0	63.0	64.0
12:45 AM	31.0	69.0	66.0	65.0	67.0	66.0	68.0	68.0	68.0	66.0	66.0	66.0	68.0	69.0	69.0	70.0
1:00 AM	31.0	70.0	65.0	65.0	66.0	67.0	67.0	68.0	67.0	66.0	66.0	66.0	68.0	69.0	68.0	71.0
1:15 AM	31.0	70.0	65.0	64.0	66.0	66.0	67.0	67.0	67.0	66.0	65.0	66.0	68.0	68.0	68.0	69.0
1:30 AM	30.0	69.0	65.0	65.0	65.0	66.0	66.0	67.0	66.0	66.0	65.0	66.0	67.0	69.0	68.0	68.0
1:45 AM	30.0	69.0	65.0	64.0	66.0	66.0	67.0	66.0	66.0	65.0	64.0	65.0	67.0	68.0	69.0	71.0
2:00 AM	30.0	69.0	65.0	64.0	66.0	66.0	66.0	68.0	66.0	65.0	64.0	65.0	67.0	68.0	69.0	70.0
2:15 AM	30.0	68.0	65.0	64.0	66.0	66.0	66.0	67.0	66.0	66.0	65.0	65.0	67.0	68.0	68.0	69.0
2:30 AM	30.0	69.0	65.0	64.0	66.0	66.0	67.0	66.0	67.0	66.0	66.0	66.0	67.0	69.0	68.0	68.0
2:45 AM	30.0	70.0	65.0	65.0	66.0	66.0	66.0	65.0	67.0	66.0	66.0	66.0	68.0	69.0	69.0	68.0
3:00 AM	30.0	70.0	65.0	65.0	66.0	66.0	66.0	67.0	66.0	66.0	65.0	65.0	67.0	68.0	69.0	69.0
3:15 AM	29.0	70.0	66.0	65.0	66.0	67.0	67.0	68.0	67.0	67.0	66.0	66.0	67.0	69.0	69.0	71.0
3:30 AM	29.0	70.0	66.0	66.0	67.0	67.0	67.0	67.0	68.0	67.0	67.0	67.0	70.0	69.0	69.0	71.0
3:45 AM	29.0	68.0	66.0	66.0	67.0	67.0	67.0	67.0	67.0	67.0	68.0	68.0	69.0	69.0	69.0	69.0
4:00 AM	30.0	70.0	69.0	69.0	69.0	70.0	69.0	69.0	69.0	69.0	69.0	68.0	70.0	70.0	71.0	71.0
4:15 AM	31.0	71.0	69.0	68.0	68.0	68.0	68.0	68.0	70.0	70.0	70.0	70.0	71.0	70.0	71.0	72.0
4:30 AM	33.0	71.0	69.0	68.0	68.0	68.0	68.0	69.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0
4:45 AM	33.0	72.0	69.0	69.0	69.0	70.0	69.0	69.0	70.0	70.0	70.0	70.0	70.0	71.0	71.0	72.0
5:00 AM	33.0	71.0	70.0	70.0	70.0	71.0	70.0	70.0	72.0	71.0	72.0	73.0	72.0	72.0	71.0	72.0
5:15 AM	33.0	71.0	70.0	69.0	70.0	69.0	69.0	69.0	71.0	71.0	69.0	70.0	70.0	70.0	71.0	72.0
5:30 AM	32.0	70.0	69.0	69.0	68.0	68.0	68.0	69.0	70.0	68.0	68.0	69.0	69.0	68.0	69.0	70.0
5:45 AM	31.0	70.0	71.0	69.0	68.0	68.0	69.0	70.0	70.0	68.0	70.0	71.0	70.0	70.0	69.0	70.0
6:00 AM	29.0	68.0	68.0	66.0	65.0	66.0	65.0	67.0	67.0	67.0	69.0	69.0	69.0	68.0	69.0	69.0
6:15 AM	29.0	68.0	66.0	65.0	64.0	65.0	64.0	65.0	66.0	64.0	65.0	67.0	68.0	66.0	67.0	67.0
6:30 AM	30.0	64.0	64.0	63.0	61.0	61.0	61.0	61.0	62.0	62.0	64.0	65.0	65.0	64.0	66.0	68.0
6:45 AM	30.0	55.0	44.0	45.0	51.0	55.0	56.0	56.0	58.0	61.0	63.0	65.0	65.0	65.0	66.0	66.0
7:00 AM	30.0	38.0	31.0	40.0	49.0	52.0	53.0	55.0	58.0	59.0	62.0	63.0	66.0	65.0	66.0	67.0
7:15 AM	30.0	24.0	25.0	36.0	46.0	52.0	54.0	53.0	56.0	59.0	62.0	64.0	66.0	64.0	66.0	66.0
7:30 AM	30.0	20.0	24.0	33.0	41.0	46.0	46.0	50.0	55.0	59.0	62.0	65.0	66.0	64.0	66.0	67.0
7:45 AM	32.0	18.0	23.0	29.0	36.0	41.0	43.0	45.0	52.0	57.0	62.0	65.0	66.0	64.0	67.0	68.0
8:00 AM	30.0	17.0	20.0	28.0	34.0	38.0	37.0	43.0	53.0	57.0	62.0	65.0	66.0	64.0	67.0	67.0
8:15 AM	30.0	15.0	23.0	29.0	34.0	36.0	35.0	39.0	50.0	56.0	61.0	65.0	66.0	64.0	67.0	67.0
8:30 AM	29.0	15.0	20.0	28.0	35.0	38.0	38.0	42.0	50.0	56.0	60.0	64.0	64.0	64.0	66.0	67.0
8:45 AM	29.0	15.0	24.0	30.0	35.0	40.0	42.0	44.0	51.0	57.0	60.0	64.0	64.0	63.0	66.0	66.0
9:00 AM	29.0	14.0	21.0	30.0	35.0	40.0	38.0	41.0	52.0	57.0	61.0	64.0	64.0	63.0	65.0	66.0
9:15 AM	30.0	17.0	24.0	32.0	39.0	42.0	43.0	47.0	54.0	57.0	61.0	64.0	66.0	65.0	67.0	67.0
9:30 AM	31.0	20.0	28.0	37.0	42.0	45.0	45.0	46.0	52.0	60.0	61.0	63.0	64.0	63.0	66.0	66.0
9:45 AM	31.0	32.0	27.0	38.0	44.0	49.0	50.0	50.0	53.0	58.0	61.0	64.0	64.0	63.0	64.0	66.0
10:00 AM	30.0	38.0	34.0	47.0	51.0	54.0	55.0	55.0	56.0	62.0	63.0	66.0	65.0	64.0	66.0	66.0
10:15 AM	31.0	61.0	44.0	46.0	54.0	55.0	58.0	59.0	60.0	62.0	64.0	64.0	65.0	64.0	66.0	66.0
10:30 AM	30.0	66.0	59.0	52.0	53.0	56.0	62.0	64.0	64.0	65.0	65.0	66.0	65.0	65.0	66.0	66.0
10:45 AM	31.0	66.0	64.0	62.0	66.0	63.0	65.0	66.0	66.0	65.0	66.0	68.0	68.0	67.0	70.0	70.0
11:00 AM	30.0	67.0	65.0	64.0	64.0	64.0	64.0	65.0	66.0	66.0	67.0	67.0	66.0	65.0	67.0	67.0
11:15 AM	30.0	66.0	65.0	65.0	62.0	63.0	62.0	65.0	67.0	68.0	68.0	69.0	69.0	68.0	69.0	69.0
11:30 AM	31.0	64.0	64.0	65.0	65.0	65.0	65.0	65.0	67.0	66.0	66.0	67.0	67.0	67.0	68.0	68.0
11:45 AM	30.0	65.0	67.0	65.0	64.0	63.0	63.0	64.0	65.0	64.0	66.0	66.0	66.0	66.0	68.0	68.0
12:00 PM	30.0	68.0	66.0	66.0	66.0	65.0	65.0	65.0	67.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0
12:15 PM	30.0	68.0	66.0	66.0	64.0	64.0	65.0	65.0	66.0	66.0	66.0	68.0	67.0	66.0	68.0	68.0
12:30 PM	30.0	69.0	67.0	65.0	64.0	64.0	65.0	66.0	68.0	67.0	67.0	67.0	67.0	66.0	68.0	68.0
12:45 PM	30.0	70.0	68.0	65.0	65.0	65.0	65.0	66.0	67.0	66.0	67.0	68.0	67.0	67.0	68.0	68.0
1:00 PM	32.0	70.0	67.0	65.0	66.0	66.0	66.0	67.0	68.0	67.0	68.0	67.0	68.0	67.0	68.0	68.0
1:15 PM	32.0	70.0	67.0	66.0	66.0	65.0	65.0	66.0	67.0	66.0	66.0	67.0	67.0	66.0	67.0	68.0
1:30 PM	32.0	67.0	67.0	67.0	66.0	65.0	66.0	64.0	66.0	66.0	66.0	68.0	68.0	66.0	68.0	68.0
1:45 PM	32.0	68.0	67.0	67.0	66.0	66.0	67.0	65.0	67.0	67.0	69.0	70.0	70.0	67.0	68.0	68.0
2:00 PM	31.0	69.0	67.0	65.0	65.0	65.0	65.0	66.0	67.0	66.0	68.0	69.0	69.0	67.0	68.0	68.0
2:15 PM	30.0	67.0	64.0	62.0	61.0	61.0	64.0	65.0	65.0	64.0	65.0	68.0	67.0	66.0	67.0	67.0
2:30 PM	31.0	67.0	65.0	63.0	62.0	61.0	63.0	62.0	64.0	64.0	65.0	67.0	66.0	65.0	68.0	68.0
2:45 PM	30.0	68.0	65.0	64.0	63.0	63.0	63.0	64.0	64.0	64.0	66.0	66.0	66.0	67.0	68.0	68.0
3:00 PM	30.0	68.0	67.0	65.0	65.0	65.0	65.0	65.0	63.0	62.0	65.0	66.0	67.0	66.0	68.0	68.0
3:15 PM	31.0	66.0	63.0	62.0	62.0	61.0	62.0	61.0	61.0	64.0	65.0	67.0	67.0	65.0	68.0	68.0
3:30 PM	30.0	67.0	65.0	65.0	63.0	64.0	66.0	61.0	62.0	62.0	65.0	66.0	66.0	66.0	68.0	68.0
3:45 PM	31.0	66.0	65.0	63.0	63.0	63.0	63.0	63.0	64.0	63.0	65.0	66.0	66.0	66.0	68.0	68.0
4:00 PM	30.0	68.0	64.0	64.0	64.0	64.0	66.0	64.0	64.0	64.0	66.0	67.0	67.0	66.0	67.0	68.0
4:15 PM	30.0	65.0	61.0	61.0	61.0	62.0	64.0	64.0	63.0	63.0	65.0	66.0	67.0	65.0	68.0	68.0
4:30 PM	30.0	65.0	60.0	55.0	55.0	60.0	62.0	60.0	62.0	63.0	65.0	66.0	67.0	66.0	67.0	69.0
4:45 PM	30.0	61.0	50.0	53.0	55.0	60.0	60.0	58.0	58.0	62.0	64.0	65.0	65.0	65.0	67.0	69.0
5:00 PM	31.0	39.0	30.0	46.0	48.0	54.0	55.0	54.0	55.0	58.0	61.0	62.0	63.0	62.0	65.0	66.0
5:15 PM	30.0	31.0	32.0	44.0	48.0	54.0	54.0	54.0	55.0	57.0	60.0	61.0	62.0	60.0	63.0	65.0
5:30 PM	30.0	24.0	31.0	43.0	48.0	55.0	56.0	54.0	54.0	56.0	59.0	61.0	61.0	61.0	63.0	65.0
5:45 PM	30.0	25.0	31.0	44.0	49.0	53.0	53.0	53.0	54.0	57.0	59.0	61.0	62.0	60.0	63.0	65.0
6:00 PM	31.0	28.0	32.0	41.0	47.0	53.0	53.0	54.0	54.0	56.0	60.0	62.0	63.0	61.0	64.0	65.0
6:15 PM	30.0	45.0	38.0	50.0	50.0	54.0	54.0	54.0	55.0	56.0	60.0	62.0	62.0	61.0	64.0	65.0
6:30 PM	30.0	61.0	58.0	58.0	55.0	57.0	58.0	56.0	56.0	59.0	61.0	62.0	63.0	62.0	65.0	65.0
6:45 PM	30.0	65.0	63.0	62.0	63.0	61.0	62.0	63.0	62.0	61.0	63.0	63.0	64.0	63.0	67.0	66.0
7:00 PM	29.0	68.0	65.0	65.0	63.0	65.0	64.0	65.0	65.0	64.0	64.0	66.0	66.0	64.0	68.0	68.0
7:15 PM	30.0	69.0	66.0	67.0	66.0	67.0	67.0	67.0	67.0	65.0	66.0	67.0	68.0	67.0	69.0	68.0
7:30 PM	30.0	69.0	68.0	67.0	67.0	66.0	67.0	68.0	68.0	67.0	67.0	68.0	68.0	68.0	68.0	68.0
7:45 PM	32.0	69.0	67.0	67.0	66.0	65.0	67.0	67.0	68.0	67.0	68.0	69.0	68.0	67.0	68.0	68.0
8:00 PM	31.0	70.0	70.0	67.0	69.0	67.0	69.0	69.0	67.0	67.0	67.0	68.0	67.0	68.0	68.0	68.0
8:15 PM	30.0	71.0	71.0	69.0	69.0	71.0	71.0	70.0	71.0	70.0	71.0	71.0	72.0	69.0	71.0	72.0
8:30 PM	30.0	70.0	68.0	68.0	69.0	68.0	70.0	72.0	71.0	69.0	69.0	69.0	70.0	68.0	70.0	70.0
8:45 PM	29.0	69.0	66.0	66.0	67.0	67.0	67.0	67.0	69.0	68.0	68.0	68.0	68.0	68.0	69.0	69.0
9:00 PM	31.0	69.0	68.0	67.0	66.0	67.0	67.0	68.0	70.0	69.0	68.0	68.0	68.0	68.0	70.0	69.0
9:15 PM	31.0	70.0	69.0	69.0	71.0	69.0	69.0	71.0	70.0	70.0	70.0	70.0	71.0	70.0	70.0	70.0
9:30 PM	31.0	71.0	69.0	68.0	69.0	67.0	67.0	68.0	69.0	67.0	69.0	70.0	70.0	67.0	69.0	70.0
9:45 PM	32.0	69.0	67.0	67.0	67.0	67.0	67.0	68.0	69.0	68.0	68.0	69.0	69.0	68.0	69.0	69.0
10:00 PM	32.0	70.0	69.0	68.0	68.0	68.0	69.0	71.0	71.0	69.0	69.0	69.0	69.0	69.0	69.0	70.0
10:15 PM	31.0	70.0	69.0	67.0	67.0	67.0	67.0	67.0	69.0	67.0	66.0	66.0	69.0	68.0	69.0	70.0
10:30 PM	31.0	69.0	67.0	67.0	67.0	68.0	67.0	67.0	68.0	67.0	66.0	68.0	68.0	68.0	68.0	68.0
10:45 PM	30.0	69.0	68.0	66.0	67.0	67.0	67.0	66.0	68.0	66.0	66.0	67.0	67.0	67.0	68.0	68.0
11:00 PM	30.0	69.0	65.0	64.0	66.0	66.0	66.0	67.0	67.0	66.0	66.0	66.0	67.0	67.0	68.0	68.0
11:15 PM	30.0	69.0	65.0	65.0	66.0	66.0	66.0	66.0	67.0	66.0	67.0	67.0	68.0	68.0	69.0	69.0
11:30 PM	29.0	70.0	67.0	65.0	66.0	66.0	66.0	67.0	67.0	66.0	66.0	67.0	67.0	67.0	68.0	68.0
11:45 PM	30.0	67.0	65.0	65.0	66.0	66.0	66.0	67.0	67.0	66.0	67.0	67.0	67.0	68.0	68.0	68.0

Target Time	East of Ocho Rios Dr to East of Diablo Hills Country School	East of Diablo Hills Country School to East of Fountain Springs Cir	East of Fountain Springs Cir to East of Gold Coin Car Wash	East of Gold Coin Car Wash to Crow Canyon Rd Off-Ramp	Crow Canyon Rd Off-Ramp to Crow Canyon Rd Loop On-Ramp	Crow Canyon Rd Loop On-Ramp to Crow Canyon Rd Diag On-Ramp	Crow Canyon Rd Diag On-Ramp to Bollinger Canyon Rd Off-Ramp	Bollinger Canyon Rd Off-Ramp to Bollinger Canyon Rd Loop On-Ramp	Bollinger Canyon Rd Loop On-Ramp to Bollinger Canyon Rd Diag On_Ramp	Bollinger Canyon Rd Diag On_Ramp to East of Morgan Dr	East of Morgan Dr to East of Westside Dr	East of Westside Dr to East of Terraced Hills Way	East of Terraced Hills Way to East of Valley Vista Senior Housing	East of Valley Vista Senior Housing to San Ramon Valley Blvd Off-Ramp	San Ramon Valley Blvd Off-Ramp to San Ramon Valley Blvd On-Ramp	San Ramon Valley Blvd On-Ramp to Alcosta Blvd On-Ramp	Alcosta Blvd On-Ramp to I-580 Eastbound Off-Ramp	I-580 Eastbound Off-Ramp to Amador Plaza Road Off-Ramp	Amador Plaza Road Off-Ramp to Amador Plaza/St Patrick Intersection
12:00 AM	69.0	67.0	67.0	65.0	67.0	67.0	67.0	66.0	66.0	67.0	67.0	67.0	68.0	68.0	67.0	67.0	69.0	60.0	32.0
12:15 AM	64.0	64.0	63.0	63.0	62.0	61.0	62.0	63.0	63.0	63.0	63.0	63.0	65.0	65.0	63.0	65.0	65.0	58.0	32.0
12:30 AM	63.0	63.0	63.0	63.0	63.0	63.0	63.0	63.0	63.0	63.0	63.0	64.0	63.0	63.0	63.0	63.0	63.0	58.0	29.0
12:45 AM	69.0	67.0	66.0	66.0	67.0	67.0	68.0	68.0	67.0	68.0	68.0	67.0	67.0	68.0	67.0	67.0	69.0	58.0	28.0
1:00 AM	69.0	68.0	67.0	66.0	66.0	67.0	69.0	67.0	67.0	67.0	67.0	67.0	66.0	67.0	67.0	67.0	68.0	58.0	27.0
1:15 AM	68.0	67.0	66.0	65.0	67.0	67.0	68.0	66.0	66.0	67.0	67.0	66.0	66.0	67.0	66.0	66.0	69.0	57.0	26.0
1:30 AM	67.0	67.0	65.0	65.0	66.0	67.0	68.0	67.0	66.0	67.0	67.0	66.0	66.0	67.0	66.0	66.0	68.0	57.0	25.0
1:45 AM	67.0	66.0	65.0	65.0	66.0	67.0	68.0	67.0	66.0	67.0	67.0	65.0	66.0	66.0	65.0	66.0	69.0	57.0	26.0
2:00 AM	67.0	67.0	65.0	65.0	66.0	67.0	68.0	65.0	66.0	66.0	67.0	66.0	66.0	66.0	66.0	66.0	68.0	57.0	29.0
2:15 AM	69.0	67.0	65.0	65.0	66.0	67.0	68.0	66.0	66.0	67.0	67.0	67.0	66.0	66.0	66.0	66.0	67.0	58.0	31.0
2:30 AM	68.0	67.0	65.0	65.0	66.0	67.0	68.0	66.0	66.0	67.0	67.0	67.0	67.0	67.0	66.0	67.0	68.0	58.0	32.0
2:45 AM	68.0	67.0	65.0	65.0	67.0	67.0	68.0	67.0	66.0	67.0	67.0	67.0	66.0	67.0	66.0	66.0	69.0	58.0	34.0
3:00 AM	69.0	66.0	66.0	66.0	67.0	67.0	68.0	67.0	66.0	67.0	67.0	66.0	65.0	67.0	66.0	66.0	69.0	58.0	36.0
3:15 AM	69.0	67.0	66.0	66.0	67.0	68.0	68.0	67.0	66.0	67.0	67.0	66.0	65.0	67.0	66.0	66.0	69.0	58.0	36.0
3:30 AM	71.0	69.0	68.0	67.0	69.0	69.0	69.0	68.0	68.0	68.0	68.0	68.0	67.0	68.0	67.0	67.0	69.0	59.0	35.0
3:45 AM	70.0	69.0	68.0	67.0	68.0	68.0	68.0	69.0	68.0	69.0	68.0	68.0	67.0	68.0	68.0	68.0	69.0	60.0	34.0
4:00 AM	73.0	70.0	67.0	68.0	69.0	69.0	71.0	69.0	68.0	69.0	69.0	70.0	70.0	70.0	68.0	67.0	70.0	60.0	34.0
4:15 AM	73.0	72.0	71.0	70.0	72.0	71.0	70.0	72.0	72.0	70.0	70.0	70.0	71.0	71.0	70.0	69.0	71.0	60.0	34.0
4:30 AM	71.0	71.0	71.0	71.0	71.0	70.0	70.0	71.0	70.0	70.0	70.0	71.0	70.0	71.0	71.0	71.0	71.0	62.0	33.0
4:45 AM	73.0	71.0	70.0	70.0	71.0	70.0	70.0	71.0	70.0	71.0	71.0	72.0	71.0	71.0	72.0	72.0	71.0	60.0	34.0
5:00 AM	72.0	72.0	72.0	72.0	72.0	71.0	71.0	72.0	72.0	71.0	71.0	71.0	69.0	70.0	70.0	70.0	70.0	59.0	33.0
5:15 AM	72.0	71.0	71.0	71.0	71.0	71.0	71.0	73.0	72.0	71.0	71.0	72.0	71.0	71.0	72.0	71.0	70.0	60.0	32.0
5:30 AM	70.0	71.0	71.0	70.0	71.0	69.0	70.0	72.0	71.0	70.0	70.0	71.0	70.0	70.0	72.0	72.0	71.0	59.0	33.0
5:45 AM	72.0	71.0	71.0	71.0	71.0	71.0	72.0	72.0	71.0	71.0	71.0	71.0	70.0	71.0	71.0	71.0	71.0	62.0	32.0
6:00 AM	70.0	71.0	69.0	70.0	71.0	71.0	72.0	72.0	70.0	72.0	72.0	71.0	70.0	72.0	72.0	72.0	72.0	63.0	36.0
6:15 AM	69.0	70.0	69.0	70.0	69.0	69.0	71.0	73.0	71.0	71.0	72.0	72.0	70.0	71.0	71.0	70.0	69.0	60.0	37.0
6:30 AM	69.0	70.0	69.0	69.0	69.0	69.0	69.0	71.0	69.0	68.0	69.0	69.0	69.0	70.0	70.0	69.0	68.0	59.0	34.0
6:45 AM	68.0	69.0	68.0	68.0	69.0	68.0	69.0	71.0	69.0	69.0	69.0	70.0	68.0	68.0	69.0	67.0	67.0	59.0	36.0
7:00 AM	69.0	70.0	68.0	67.0	68.0	68.0	70.0	70.0	70.0	70.0	71.0	71.0	69.0	69.0	71.0	70.0	69.0	62.0	39.0
7:15 AM	68.0	70.0	69.0	68.0	68.0	67.0	69.0	70.0	69.0	69.0	68.0	69.0	68.0	69.0	70.0	70.0	67.0	59.0	36.0
7:30 AM	69.0	70.0	70.0	68.0	67.0	68.0	68.0	69.0	68.0	69.0	70.0	71.0	70.0	70.0	70.0	68.0	68.0	59.0	38.0
7:45 AM	70.0	71.0	71.0	70.0	70.0	69.0	70.0	72.0	69.0	69.0	70.0	69.0	68.0	68.0	68.0	68.0	67.0	57.0	37.0
8:00 AM	71.0	72.0	71.0	70.0	70.0	69.0	70.0	69.0	69.0	70.0	69.0	69.0	67.0	68.0	68.0	66.0	65.0	58.0	38.0
8:15 AM	69.0	70.0	70.0	68.0	69.0	68.0	69.0	70.0	68.0	69.0	69.0	68.0	68.0	69.0	69.0	67.0	65.0	58.0	35.0
8:30 AM	69.0	69.0	68.0	67.0	68.0	65.0	68.0	70.0	68.0	66.0	69.0	70.0	69.0	68.0	67.0	66.0	64.0	58.0	36.0
8:45 AM	66.0	69.0	68.0	67.0	68.0	66.0	67.0	71.0	68.0	69.0	70.0	69.0	67.0	68.0	67.0	65.0	67.0	57.0	34.0
9:00 AM	69.0	69.0	69.0	68.0	69.0	68.0	70.0	71.0	70.0	69.0	70.0	69.0	68.0	68.0	69.0	68.0	68.0	59.0	34.0
9:15 AM	69.0	69.0	68.0	67.0	69.0	68.0	69.0	70.0	68.0	68.0	68.0	68.0	67.0	67.0	68.0	67.0	67.0	59.0	36.0
9:30 AM	69.0	69.0	69.0	68.0	67.0	66.0	68.0	68.0	66.0	69.0	70.0	68.0	67.0	67.0	69.0	70.0	66.0	59.0	33.0
9:45 AM	68.0	68.0	67.0	66.0	67.0	66.0	69.0	70.0	68.0	68.0	69.0	68.0	67.0	68.0	68.0	67.0	67.0	58.0	33.0
10:00 AM	69.0	70.0	69.0	67.0	67.0	66.0	68.0	68.0	67.0	66.0	66.0	67.0	68.0	67.0	68.0	67.0	67.0	59.0	33.0
10:15 AM	68.0	69.0	69.0	68.0	67.0	66.0	69.0	68.0	67.0	66.0	67.0	69.0	67.0	67.0	68.0	67.0	66.0	59.0	34.0
10:30 AM	68.0	68.0	67.0	66.0	67.0	66.0	67.0	68.0	67.0	67.0	67.0	68.0	67.0	66.0	66.0	67.0	67.0	60.0	35.0
10:45 AM	71.0	71.0	70.0	69.0	69.0	68.0	69.0	70.0	68.0	69.0	70.0	69.0	68.0	69.0	69.0	68.0	68.0	59.0	35.0
11:00 AM	70.0	72.0	70.0	70.0	70.0	67.0	70.0	70.0	70.0	69.0	70.0	71.0	68.0	68.0	70.0	70.0	70.0	60.0	36.0
11:15 AM	72.0	72.0	71.0	70.0	70.0	68.0	70.0	71.0	69.0	69.0	70.0	69.0	68.0	68.0	68.0	69.0	67.0	59.0	35.0
11:30 AM	70.0	72.0	70.0	69.0	69.0	69.0	69.0	70.0	69.0	68.0	68.0	69.0	69.0	68.0	68.0	68.0	68.0	60.0	35.0
11:45 AM	71.0	69.0	69.0	69.0	68.0	66.0	67.0	69.0	65.0	65.0	67.0	68.0	67.0	68.0	67.0	66.0	67.0	60.0	36.0
12:00 PM	70.0	71.0	69.0	69.0	69.0	68.0	70.0	69.0	68.0	68.0	69.0	68.0	68.0	69.0	66.0	68.0	67.0	59.0	33.0
12:15 PM	72.0	72.0	70.0	69.0	69.0	67.0	68.0	69.0	67.0	68.0	69.0	69.0	68.0	68.0	68.0	68.0	70.0	60.0	33.0
12:30 PM	71.0	71.0	69.0	68.0	68.0	68.0	69.0	70.0	67.0	70.0	70.0	70.0	69.0	69.0	69.0	68.0	67.0	59.0	35.0
12:45 PM	70.0	70.0	69.0	69.0	68.0	66.0	67.0	68.0	67.0	69.0	69.0	69.0	68.0	68.0	68.0	67.0	68.0	60.0	35.0
1:00 PM	69.0	69.0	69.0	67.0	68.0	66.0	66.0	67.0	67.0	67.0	68.0	68.0	67.0	68.0	68.0	69.0	69.0	60.0	35.0
1:15 PM	69.0	69.0	69.0	69.0	69.0	68.0	68.0	70.0	68.0	69.0	68.0	68.0	67.0	67.0	68.0	66.0	66.0	60.0	34.0
1:30 PM	70.0	71.0	69.0	68.0	69.0	69.0	68.0	69.0	67.0	68.0	70.0	69.0	68.0	68.0	68.0	67.0	66.0	59.0	34.0
1:45 PM	72.0	73.0	71.0	70.0	70.0	69.0	70.0	71.0	69.0	70.0	71.0	70.0	69.0	70.0	70.0	69.0	69.0	60.0	34.0
2:00 PM	70.0	72.0	69.0	69.0	69.0	68.0	69.0	71.0	70.0	71.0	70.0	70.0	68.0	69.0	69.0	70.0	70.0	60.0	33.0
2:15 PM	69.0	71.0	71.0	69.0	69.0	68.0	70.0	71.0	70.0	70.0	69.0	68.0	67.0	68.0	69.0	69.0	69.0	60.0	33.0
2:30 PM	69.0	69.0	68.0	66.0	67.0	67.0	68.0	68.0	66.0	67.0	68.0	67.0	66.0	67.0	67.0	66.0	67.0	59.0	34.0
2:45 PM	69.0	70.0	69.0	68.0	68.0	67.0	69.0	69.0	66.0	67.0	67.0	68.0	68.0	68.0	68.0	68.0	69.0	59.0	32.0
3:00 PM	70.0	71.0	71.0	70.0	72.0	70.0	69.0	68.0	66.0	68.0	70.0	71.0	70.0	70.0	68.0	69.0	68.0	60.0	32.0
3:15 PM	71.0	70.0	70.0	67.0	70.0	69.0	68.0	68.0	64.0	67.0	69.0	69.0	68.0	68.0	68.0	67.0	66.0	59.0	31.0
3:30 PM	70.0	70.0	70.0	69.0	70.0	67.0	70.0	68.0	65.0	66.0	68.0	68.0	66.0	65.0	66.0	67.0	65.0	59.0	31.0
3:45 PM	69.0	71.0	71.0	68.0	69.0	67.0	68.0	64.0	58.0	62.0	67.0	68.0	65.0	65.0	66.0	65.0	64.0	59.0	33.0
4:00 PM	71.0	71.0	70.0	69.0	69.0	67.0	65.0	65.0	59.0	62.0	66.0	67.0	66.0	65.0	66.0	66.0	65.0	60.0	33.0
4:15 PM	70.0	70.0	69.0	68.0	69.0	68.0	65.0	63.0	58.0	62.0	65.0	65.0	64.0	63.0	65.0	65.0	66.0	58.0	31.0
4:30 PM	70.0	71.0	72.0	68.0	69.0	68.0	66.0	46.0	39.0	51.0	65.0	67.0	64.0	64.0	67.0	67.0	67.0	58.0	33.0
4:45 PM	70.0	70.0	69.0	67.0	68.0	64.0	50.0	31.0	27.0	45.0	61.0	64.0	63.0	64.0	66.0	67.0	65.0	58.0	34.0
5:00 PM	67.0	68.0	67.0	66.0	64.0	58.0	48.0	27.0	26.0	41.0	59.0	63.0	63.0	63.0	64.0	63.0	64.0	58.0	33.0
5:15 PM	67.0	67.0	65.0	62.0	48.0	35.0	34.0	25.0	26.0	42.0	59.0	61.0	61.0	60.0	62.0	63.0	63.0	57.0	32.0
5:30 PM	65.0	67.0	64.0	61.0	45.0	32.0	28.0	22.0	21.0	41.0	54.0	59.0	59.0	59.0	62.0	63.0	64.0	57.0	31.0
5:45 PM	68.0	68.0	66.0	63.0	56.0	39.0	26.0	24.0	25.0	45.0	56.0	59.0	58.0	60.0	62.0	62.0	62.0	55.0	29.0
6:00 PM	67.0	68.0	66.0	63.0	60.0	55.0	58.0	35.0	32.0	46.0	59.0	59.0	59.0	59.0	62.0	65.0	65.0	57.0	33.0
6:15 PM	67.0	67.0	66.0	64.0	66.0	63.0	62.0	47.0	35.0	48.0	58.0	60.0	60.0	59.0	62.0	62.0	61.0	56.0	31.0
6:30 PM	68.0	69.0	69.0	67.0	67.0	65.0	64.0	65.0	59.0	65.0	65.0	64.0	62.0	63.0	67.0	66.0	66.0	58.0	31.0
6:45 PM	69.0	70.0	70.0	69.0	69.0	68.0	66.0	67.0	64.0	66.0	67.0	68.0	66.0	65.0	68.0	67.0	66.0	59.0	33.0
7:00 PM	69.0	69.0	68.0	67.0	68.0	66.0	68.0	70.0	68.0	68.0	68.0	70.0	68.0	69.0	69.0	69.0	68.0	58.0	35.0
7:15 PM	70.0	71.0	69.0	68.0	68.0	67.0	67.0	68.0	67.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	58.0	33.0
7:30 PM	69.0	70.0	69.0	68.0	68.0	67.0	68.0	68.0	69.0	69.0	69.0	69.0	68.0	68.0	68.0	68.0	67.0	59.0	32.0
7:45 PM	70.0	70.0	70.0	68.0	69.0	67.0	68.0	69.0	67.0	67.0	67.0	68.0	66.0	67.0	67.0	68.0	69.0	59.0	33.0
8:00 PM	71.0	71.0	70.0	70.0	69.0	68.0	69.0	70.0	69.0	69.0	71.0	70.0	68.0	68.0	68.0	68.0	69.0	60.0	34.0
8:15 PM	73.0	72.0	71.0	70.0	71.0	70.0	70.0	71.0	69.0	70.0	71.0	71.0	68.0	70.0	70.0	71.0	71.0	59.0	33.0
8:30 PM	70.0	70.0	69.0	69.0	69.0	68.0	70.0	69.0	69.0	68.0	67.0	70.0	70.0	70.0	69.0	68.0	70.0	61.0	32.0
8:45 PM	70.0	70.0	70.0	68.0	68.0	69.0	70.0	68.0	70.0	71.0	71.0	71.0	70.0	70.0	69.0	69.0	70.0	61.0	33.0
9:00 PM	69.0	71.0	69.0	67.0	69.0	68.0	69.0	70.0	71.0	70.0	71.0	72.0	69.0	70.0	70.0	70.0	71.0	61.0	33.0
9:15 PM	74.0	71.0	71.0	69.0	71.0	68.0	72.0	73.0	71.0	72.0	72.0	73.0	74.0	73.0	73.0	72.0	72.0	60.0	32.0
9:30 PM	71.0	71.0	70.0	68.0	70.0	69.0	70.0	71.0	69.0	70.0	70.0	69.0	69.0	70.0	69.0	70.0	71.0	60.0	31.0
9:45 PM	71.0	69.0	68.0	67.0	68.0	68.0	69.0	69.0	69.0	70.0	70.0	71.0	70.0	71.0	69.0	68.0	70.0	58.0	30.0
10:00 PM	73.0	74.0	69.0	68.0	69.0	70.0	69.0	69.0	68.0	68.0	69.0	68.0	68.0	68.0	67.0	67.0	70.0	60.0	29.0
10:15 PM	70.0	69.0	68.0	66.0	68.0	69.0	69.0	69.0	68.0	68.0	68.0	68.0	68.0	69.0	67.0	67.0	70.0	61.0	29.0
10:30 PM	70.0	69.0	67.0	67.0	68.0	68.0	69.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	67.0	67.0	70.0	59.0	29.0
10:45 PM	70.0	67.0	66.0	66.0	67.0	67.0	68.0	68.0	67.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	70.0	59.0	28.0
11:00 PM	69.0	67.0	66.0	66.0	66.0	67.0	68.0	66.0	66.0	66.0	67.0	66.0	65.0	66.0	66.0	67.0	69.0	59.0	28.0
11:15 PM	69.0	67.0	65.0	65.0	67.0	67.0	68.0	67.0	67.0	67.0	67.0	66.0	65.0	67.0	66.0	67.0	69.0	58.0	27.0
11:30 PM	68.0	66.0	65.0	65.0	66.0	66.0	67.0	67.0	66.0	67.0	67.0	66.0	65.0	67.0	67.0	66.0	68.0	59.0	29.0
11:45 PM	70.0	67.0	67.0	66.0	67.0	67.0	68.0	66.0	66.0	66.0	66.0	65.0	64.0	66.0	66.0	66.0	67.0	58.0	31.0

Green	Greater than 55 mph
Yellow	45 to 55 mph
Orange	35 to 45 mph
Red	Less than 35 mph

Figure 43: Speed Contours, I-680 Control Corridor Southbound, Before Study (2014)

	Sunvalley Blvd Off-Ramp to Sunvalley Blvd On-Ramp	Sunvalley Blvd Off-Ramp to Gregory Ln/Monument Blvd Off-Ramp	Gregory Ln/Monument Blvd Off-Ramp to CA-242 On-Ramp	CA-242 On-Ramp to Monument Blvd On-Ramp	Monument Blvd On-Ramp to Main St Off-Ramp	Main St Off-Ramp to Main St On-Ramp	Main St On-Ramp to Treat Blvd On-Ramp	Treat Blvd On-Ramp to San Luis Rd Off-Ramp	San Luis Rd Off-Ramp to San Luis Rd On-Ramp	San Luis Rd On-Ramp to CA-24 Off-Ramp	CA-24 Off-Ramp to Ygnacio Valley Rd On-Ramp	Ygnacio Valley Rd On-Ramp to Olympic Blvd Off-Ramp	Olympic Blvd Off-Ramp to CA-24 On-Ramp	CA-24 On-Ramp to Olympic Blvd On-Ramp
Target Time	80th Percentile Travel Time Per Day													
12:00 AM	20.0	65.0	66.0	68.0	66.0	65.0	69.0	68.0	67.0	64.0	66.0	65.0	67.0	68.0
12:15 AM	20.0	64.0	65.0	64.0	64.0	64.0	63.0	63.0	62.0	61.0	64.0	63.0	64.0	65.0
12:30 AM	20.0	65.0	66.0	67.0	64.0	65.0	65.0	66.0	65.0	64.0	65.0	64.0	66.0	66.0
12:45 AM	20.0	65.0	66.0	68.0	65.0	65.0	70.0	69.0	67.0	64.0	66.0	66.0	68.0	69.0
1:00 AM	20.0	65.0	67.0	68.0	66.0	65.0	70.0	69.0	67.0	64.0	66.0	66.0	68.0	69.0
1:15 AM	20.0	66.0	67.0	68.0	66.0	65.0	70.0	70.0	67.0	63.0	66.0	65.0	68.0	69.0
1:30 AM	20.0	65.0	66.0	68.0	66.0	65.0	69.0	68.0	66.0	63.0	66.0	66.0	68.0	69.0
1:45 AM	20.0	65.0	66.0	68.0	66.0	65.0	69.0	69.0	67.0	64.0	66.0	66.0	68.0	69.0
2:00 AM	20.0	65.0	67.0	68.0	66.0	66.0	69.0	69.0	67.0	63.0	66.0	66.0	67.0	68.0
2:15 AM	20.0	65.0	66.0	67.0	66.0	65.0	70.0	69.0	68.0	65.0	66.0	66.0	68.0	69.0
2:30 AM	20.0	66.0	66.0	68.0	66.0	65.0	70.0	69.0	68.0	64.0	66.0	66.0	68.0	69.0
2:45 AM	20.0	66.0	67.0	68.0	65.0	65.0	70.0	69.0	68.0	64.0	66.0	65.0	68.0	69.0
3:00 AM	20.0	66.0	66.0	68.0	65.0	65.0	70.0	69.0	67.0	64.0	66.0	66.0	68.0	70.0
3:15 AM	20.0	65.0	66.0	68.0	66.0	66.0	69.0	69.0	67.0	64.0	66.0	66.0	68.0	70.0
3:30 AM	20.0	65.0	65.0	67.0	65.0	64.0	68.0	67.0	66.0	63.0	67.0	66.0	68.0	70.0
3:45 AM	20.0	65.0	65.0	68.0	65.0	65.0	68.0	68.0	66.0	63.0	66.0	66.0	68.0	70.0
4:00 AM	20.0	66.0	66.0	68.0	66.0	65.0	68.0	68.0	66.0	62.0	65.0	64.0	67.0	69.0
4:15 AM	56.0	67.0	68.0	69.0	69.0	69.0	70.0	70.0	69.0	66.0	67.0	66.0	69.0	70.0
4:30 AM	56.0	68.0	69.0	70.0	68.0	70.0	70.0	68.0	67.0	66.0	67.0	66.0	69.0	69.0
4:45 AM	56.0	66.0	68.0	70.0	68.0	69.0	68.0	67.0	66.0	65.0	68.0	66.0	68.0	69.0
5:00 AM	55.0	70.0	71.0	69.0	69.0	70.0	69.0	68.0	67.0	66.0	69.0	69.0	69.0	70.0
5:15 AM	54.0	69.0	70.0	68.0	68.0	68.0	68.0	67.0	66.0	64.0	68.0	68.0	68.0	69.0
5:30 AM	54.0	69.0	69.0	67.0	67.0	68.0	67.0	66.0	64.0	63.0	66.0	67.0	67.0	70.0
5:45 AM	53.0	67.0	68.0	66.0	65.0	66.0	65.0	63.0	62.0	61.0	65.0	66.0	67.0	70.0
6:00 AM	51.0	68.0	69.0	65.0	64.0	65.0	64.0	61.0	60.0	60.0	65.0	65.0	66.0	68.0
6:15 AM	49.0	65.0	63.0	59.0	59.0	57.0	52.0	49.0	51.0	57.0	63.0	64.0	65.0	66.0
6:30 AM	44.0	61.0	49.0	39.0	31.0	31.0	29.0	30.0	38.0	52.0	59.0	61.0	63.0	65.0
6:45 AM	41.0	57.0	36.0	25.0	23.0	24.0	25.0	28.0	37.0	49.0	58.0	60.0	62.0	63.0
7:00 AM	34.0	55.0	28.0	21.0	21.0	23.0	24.0	25.0	36.0	49.0	57.0	60.0	61.0	62.0
7:15 AM	31.0	52.0	20.0	17.0	18.0	23.0	23.0	24.0	33.0	42.0	56.0	59.0	60.0	58.0
7:30 AM	28.0	45.0	18.0	15.0	16.0	17.0	18.0	19.0	21.0	26.0	51.0	55.0	56.0	50.0
7:45 AM	23.0	28.0	12.0	11.0	12.0	13.0	14.0	15.0	19.0	25.0	51.0	57.0	59.0	57.0
8:00 AM	24.0	21.0	11.0	12.0	13.0	17.0	18.0	17.0	21.0	28.0	52.0	57.0	60.0	59.0
8:15 AM	29.0	21.0	15.0	15.0	16.0	19.0	19.0	20.0	24.0	29.0	52.0	56.0	58.0	57.0
8:30 AM	24.0	33.0	15.0	15.0	17.0	21.0	21.0	21.0	24.0	29.0	51.0	56.0	57.0	45.0
8:45 AM	31.0	45.0	21.0	19.0	19.0	22.0	20.0	20.0	23.0	29.0	52.0	57.0	55.0	48.0
9:00 AM	38.0	63.0	58.0	39.0	30.0	31.0	29.0	27.0	33.0	38.0	50.0	53.0	56.0	54.0
9:15 AM	39.0	65.0	62.0	60.0	48.0	41.0	33.0	30.0	36.0	48.0	54.0	58.0	61.0	64.0
9:30 AM	38.0	66.0	65.0	64.0	62.0	62.0	60.0	57.0	54.0	56.0	60.0	61.0	62.0	65.0
9:45 AM	40.0	65.0	65.0	64.0	62.0	64.0	63.0	61.0	61.0	60.0	62.0	63.0	64.0	67.0
10:00 AM	39.0	67.0	66.0	65.0	64.0	65.0	64.0	61.0	62.0	61.0	63.0	63.0	64.0	67.0
10:15 AM	37.0	67.0	67.0	66.0	65.0	66.0	65.0	62.0	62.0	61.0	64.0	65.0	66.0	68.0
10:30 AM	38.0	67.0	67.0	66.0	65.0	66.0	65.0	62.0	63.0	62.0	66.0	66.0	66.0	68.0
10:45 AM	37.0	66.0	66.0	66.0	66.0	67.0	66.0	63.0	63.0	62.0	66.0	66.0	67.0	69.0
11:00 AM	37.0	67.0	67.0	67.0	66.0	66.0	65.0	63.0	63.0	62.0	65.0	65.0	67.0	68.0
11:15 AM	36.0	66.0	67.0	66.0	65.0	67.0	66.0	64.0	64.0	63.0	65.0	65.0	66.0	69.0
11:30 AM	36.0	65.0	66.0	66.0	65.0	66.0	65.0	62.0	63.0	62.0	64.0	64.0	65.0	67.0
11:45 AM	35.0	66.0	66.0	67.0	65.0	66.0	65.0	62.0	63.0	62.0	65.0	65.0	66.0	68.0
12:00 PM	36.0	66.0	67.0	66.0	66.0	67.0	66.0	63.0	63.0	62.0	66.0	66.0	67.0	69.0
12:15 PM	39.0	66.0	67.0	66.0	65.0	67.0	65.0	63.0	64.0	63.0	65.0	66.0	66.0	69.0
12:30 PM	36.0	66.0	67.0	66.0	66.0	66.0	65.0	63.0	64.0	62.0	65.0	65.0	66.0	68.0
12:45 PM	35.0	65.0	67.0	66.0	64.0	65.0	64.0	61.0	63.0	63.0	66.0	66.0	66.0	69.0
1:00 PM	35.0	65.0	66.0	66.0	65.0	65.0	65.0	63.0	64.0	63.0	65.0	65.0	66.0	69.0
1:15 PM	38.0	67.0	68.0	67.0	66.0	67.0	66.0	63.0	64.0	64.0	67.0	67.0	68.0	69.0
1:30 PM	30.0	65.0	67.0	66.0	65.0	67.0	65.0	63.0	63.0	62.0	66.0	65.0	66.0	69.0
1:45 PM	29.0	65.0	66.0	66.0	65.0	66.0	65.0	64.0	63.0	62.0	65.0	66.0	67.0	68.0
2:00 PM	36.0	65.0	66.0	66.0	65.0	66.0	65.0	63.0	64.0	64.0	66.0	65.0	66.0	68.0
2:15 PM	37.0	65.0	66.0	66.0	65.0	65.0	65.0	62.0	63.0	62.0	64.0	65.0	66.0	68.0
2:30 PM	32.0	66.0	67.0	67.0	66.0	66.0	64.0	62.0	63.0	62.0	65.0	65.0	65.0	68.0
2:45 PM	38.0	67.0	67.0	67.0	64.0	66.0	64.0	63.0	63.0	62.0	65.0	65.0	66.0	68.0
3:00 PM	37.0	67.0	67.0	67.0	66.0	67.0	66.0	61.0	65.0	63.0	66.0	66.0	66.0	69.0
3:15 PM	36.0	66.0	68.0	67.0	67.0	68.0	67.0	61.0	65.0	63.0	65.0	65.0	67.0	68.0
3:30 PM	38.0	66.0	66.0	67.0	66.0	67.0	66.0	61.0	65.0	63.0	65.0	65.0	66.0	68.0
3:45 PM	36.0	67.0	67.0	67.0	66.0	67.0	66.0	61.0	64.0	61.0	64.0	65.0	66.0	68.0
4:00 PM	33.0	65.0	66.0	67.0	65.0	67.0	65.0	61.0	63.0	62.0	66.0	64.0	67.0	68.0
4:15 PM	30.0	66.0	66.0	67.0	66.0	68.0	67.0	62.0	64.0	62.0	65.0	64.0	66.0	68.0
4:30 PM	32.0	65.0	67.0	66.0	66.0	67.0	66.0	63.0	64.0	62.0	65.0	64.0	65.0	68.0
4:45 PM	34.0	66.0	66.0	66.0	66.0	67.0	66.0	62.0	64.0	62.0	64.0	64.0	64.0	66.0
5:00 PM	34.0	65.0	67.0	66.0	65.0	66.0	65.0	60.0	63.0	60.0	64.0	63.0	63.0	65.0
5:15 PM	36.0	65.0	66.0	65.0	65.0	66.0	64.0	59.0	62.0	60.0	62.0	60.0	60.0	56.0
5:30 PM	27.0	64.0	65.0	65.0	65.0	66.0	64.0	58.0	61.0	59.0	60.0	58.0	55.0	43.0
5:45 PM	31.0	65.0	66.0	65.0	64.0	66.0	64.0	58.0	61.0	60.0	61.0	59.0	55.0	50.0
6:00 PM	33.0	66.0	66.0	66.0	65.0	66.0	65.0	60.0	63.0	61.0	63.0	62.0	61.0	62.0
6:15 PM	35.0	66.0	67.0	67.0	66.0	67.0	65.0	61.0	64.0	62.0	65.0	65.0	64.0	66.0
6:30 PM	38.0	65.0	67.0	66.0	65.0	66.0	66.0	60.0	63.0	61.0	63.0	64.0	65.0	67.0
6:45 PM	40.0	66.0	66.0	67.0	67.0	68.0	65.0	59.0	63.0	62.0	68.0	66.0	67.0	68.0
7:00 PM	38.0	66.0	67.0	68.0	67.0	66.0	67.0	65.0	66.0	65.0	66.0	66.0	67.0	70.0
7:15 PM	41.0	65.0	66.0	67.0	66.0	66.0	66.0	64.0	64.0	63.0	66.0	66.0	67.0	68.0
7:30 PM	40.0	66.0	67.0	67.0	66.0	68.0	65.0	64.0	64.0	63.0	65.0	65.0	67.0	68.0
7:45 PM	40.0	66.0	67.0	67.0	67.0	67.0	66.0	64.0	63.0	62.0	67.0	66.0	68.0	68.0
8:00 PM	41.0	65.0	68.0	69.0	68.0	68.0	66.0	65.0	64.0	63.0	67.0	67.0	67.0	68.0
8:15 PM	43.0	65.0	66.0	68.0	66.0	67.0	65.0	64.0	65.0	65.0	66.0	66.0	68.0	70.0
8:30 PM	43.0	65.0	65.0	68.0	66.0	65.0	66.0	65.0	65.0	63.0	65.0	66.0	68.0	69.0
8:45 PM	44.0	66.0	66.0	67.0	65.0	66.0	67.0	65.0	65.0	64.0	66.0	66.0	67.0	68.0
9:00 PM	44.0	65.0	67.0	67.0	66.0	66.0	65.0	64.0	64.0	63.0	66.0	65.0	66.0	68.0
9:15 PM	46.0	65.0	66.0	67.0	65.0	65.0	67.0	66.0	65.0	64.0	65.0	65.0	66.0	68.0
9:30 PM	47.0	65.0	66.0	67.0	66.0	66.0	67.0	65.0	65.0	63.0	65.0	65.0	67.0	68.0
9:45 PM	50.0	65.0	66.0	68.0	67.0	67.0	67.0	66.0	66.0	65.0	66.0	66.0	67.0	68.0
10:00 PM	20.0	65.0	67.0	69.0	66.0	66.0	68.0	67.0	67.0	64.0	66.0	65.0	67.0	69.0
10:15 PM	20.0	65.0	66.0	67.0	66.0	65.0	67.0	67.0	66.0	62.0	66.0	65.0	67.0	69.0
10:30 PM	20.0	64.0	65.0	67.0	65.0	66.0	67.0	66.0	65.0	63.0	66.0	65.0	68.0	69.0
10:45 PM	20.0	65.0	67.0	68.0	66.0	65.0	68.0	67.0	67.0	64.0	66.0	66.0	68.0	69.0
11:00 PM	20.0	65.0	67.0	68.0	66.0	66.0	70.0	69.0	67.0	64.0	66.0	66.0	68.0	69.0
11:15 PM	20.0	65.0	67.0	68.0	65.0	64.0	69.0	69.0	66.0	63.0	66.0	66.0	67.0	69.0
11:30 PM	20.0	65.0	66.0	68.0	65.0	65.0	69.0	67.0	66.0	64.0	66.0	66.0	68.0	69.0
11:45 PM	20.0	65.0	65.0	67.0	65.0	64.0	68.0	67.0	65.0	63.0	66.0	65.0	67.0	68.0

Green	Greater than 55 mph
Yellow	45 to 55 mph
Orange	35 to 45 mph
Red	Less than 35 mph

Figure 44: Speed Contours, I-680 Control Corridor Southbound, Supplemental Before Study (2017)

Target Time	Sunvalley Blvd Off-Ramp to Sunvalley Blvd On-Ramp	Sunvalley Blvd Off-Ramp to Gregory Ln/Monument Blvd Off-Ramp	Gregory Ln/Monument Blvd Off-Ramp to CA-242 On-Ramp	CA-242 On-Ramp to Monument Blvd On-Ramp	Monument Blvd On-Ramp to Main St Off-Ramp	Main St Off-Ramp to Main St On-Ramp	Main St On-Ramp to Treat Blvd On-Ramp	Treat Blvd On-Ramp to San Luis Rd Off-Ramp	San Luis Rd Off-Ramp to San Luis Rd On-Ramp	San Luis Rd On-Ramp to CA-24 Off-Ramp	CA-24 Off-Ramp to Ygnacio Valley Rd On-Ramp	Ygnacio Valley Rd On-Ramp to Olympic Blvd Off-Ramp	Olympic Blvd Off-Ramp to CA-24 On-Ramp	CA-24 On-Ramp to Olympic Blvd On-Ramp
	80th Percentile Travel Time Per Day													
12:00 AM	32.0	61.0	64.0	62.0	63.0	63.0	61.0	60.0	61.0	60.0	60.0	60.0	59.0	61.0
12:15 AM	32.0	61.0	61.0	62.0	63.0	64.0	62.0	61.0	62.0	61.0	59.0	58.0	60.0	60.0
12:30 AM	34.0	60.0	60.0	62.0	62.0	61.0	61.0	60.0	60.0	60.0	59.0	59.0	60.0	61.0
12:45 AM	37.0	60.0	60.0	61.0	60.0	60.0	60.0	59.0	59.0	59.0	57.0	58.0	59.0	60.0
1:00 AM	39.0	60.0	61.0	63.0	61.0	61.0	62.0	62.0	61.0	60.0	58.0	59.0	60.0	60.0
1:15 AM	40.0	61.0	60.0	61.0	61.0	61.0	61.0	61.0	60.0	60.0	60.0	60.0	61.0	61.0
1:30 AM	42.0	60.0	60.0	62.0	62.0	62.0	66.0	66.0	65.0	66.0	59.0	59.0	60.0	60.0
1:45 AM	40.0	60.0	60.0	61.0	60.0	60.0	60.0	59.0	59.0	59.0	58.0	58.0	59.0	60.0
2:00 AM	38.0	60.0	61.0	62.0	61.0	61.0	61.0	59.0	59.0	58.0	58.0	58.0	60.0	60.0
2:15 AM	36.0	59.0	60.0	64.0	62.0	62.0	62.0	61.0	60.0	59.0	58.0	58.0	59.0	61.0
2:30 AM	35.0	60.0	60.0	63.0	63.0	61.0	62.0	62.0	61.0	60.0	58.0	59.0	60.0	62.0
2:45 AM	33.0	60.0	60.0	62.0	61.0	61.0	61.0	60.0	59.0	59.0	58.0	59.0	60.0	62.0
3:00 AM	29.0	60.0	61.0	63.0	63.0	63.0	61.0	60.0	59.0	59.0	59.0	59.0	60.0	62.0
3:15 AM	27.0	61.0	62.0	64.0	64.0	65.0	64.0	64.0	62.0	63.0	60.0	61.0	61.0	62.0
3:30 AM	28.0	62.0	63.0	64.0	64.0	63.0	62.0	62.0	61.0	61.0	61.0	62.0	62.0	64.0
3:45 AM	31.0	63.0	63.0	64.0	63.0	66.0	64.0	63.0	62.0	61.0	62.0	63.0	65.0	67.0
4:00 AM	33.0	64.0	65.0	65.0	64.0	65.0	64.0	64.0	63.0	63.0	62.0	63.0	65.0	67.0
4:15 AM	36.0	65.0	65.0	68.0	66.0	66.0	65.0	63.0	62.0	65.0	64.0	64.0	66.0	68.0
4:30 AM	35.0	70.0	68.0	67.0	68.0	69.0	67.0	65.0	64.0	64.0	64.0	66.0	64.0	66.0
4:45 AM	34.0	65.0	65.0	67.0	67.0	68.0	67.0	65.0	64.0	63.0	65.0	63.0	65.0	68.0
5:00 AM	34.0	68.0	66.0	66.0	68.0	67.0	65.0	66.0	65.0	63.0	69.0	69.0	69.0	69.0
5:15 AM	32.0	69.0	68.0	64.0	65.0	66.0	65.0	64.0	63.0	60.0	66.0	66.0	68.0	70.0
5:30 AM	31.0	67.0	66.0	62.0	63.0	64.0	62.0	59.0	58.0	59.0	64.0	65.0	66.0	68.0
5:45 AM	30.0	64.0	63.0	60.0	58.0	55.0	48.0	42.0	41.0	52.0	62.0	62.0	65.0	68.0
6:00 AM	31.0	64.0	65.0	54.0	40.0	33.0	28.0	27.0	34.0	48.0	57.0	59.0	63.0	65.0
6:15 AM	30.0	62.0	60.0	33.0	22.0	22.0	22.0	22.0	31.0	41.0	56.0	58.0	62.0	64.0
6:30 AM	30.0	61.0	45.0	22.0	18.0	20.0	20.0	20.0	27.0	35.0	53.0	56.0	61.0	64.0
6:45 AM	30.0	61.0	42.0	18.0	15.0	17.0	17.0	19.0	27.0	35.0	50.0	55.0	59.0	61.0
7:00 AM	33.0	58.0	36.0	18.0	16.0	18.0	19.0	20.0	27.0	35.0	49.0	53.0	55.0	56.0
7:15 AM	32.0	60.0	35.0	16.0	15.0	17.0	16.0	16.0	21.0	26.0	48.0	53.0	53.0	40.0
7:30 AM	27.0	57.0	33.0	13.0	11.0	13.0	13.0	13.0	16.0	22.0	49.0	55.0	58.0	51.0
7:45 AM	28.0	61.0	31.0	12.0	11.0	12.0	13.0	13.0	15.0	22.0	50.0	56.0	59.0	53.0
8:00 AM	28.0	58.0	26.0	12.0	13.0	16.0	15.0	14.0	18.0	24.0	48.0	56.0	58.0	47.0
8:15 AM	27.0	61.0	39.0	15.0	14.0	17.0	18.0	18.0	19.0	24.0	43.0	49.0	52.0	37.0
8:30 AM	24.0	62.0	43.0	17.0	17.0	21.0	21.0	20.0	22.0	26.0	36.0	47.0	42.0	29.0
8:45 AM	29.0	64.0	61.0	27.0	21.0	23.0	22.0	21.0	22.0	24.0	43.0	47.0	37.0	29.0
9:00 AM	31.0	67.0	68.0	42.0	32.0	26.0	23.0	20.0	23.0	27.0	38.0	47.0	37.0	32.0
9:15 AM	31.0	66.0	67.0	63.0	58.0	46.0	40.0	34.0	34.0	43.0	50.0	50.0	41.0	34.0
9:30 AM	34.0	66.0	68.0	65.0	63.0	63.0	60.0	58.0	60.0	57.0	57.0	56.0	61.0	54.0
9:45 AM	35.0	65.0	66.0	66.0	63.0	62.0	61.0	59.0	59.0	56.0	60.0	61.0	63.0	66.0
10:00 AM	35.0	65.0	66.0	65.0	66.0	65.0	64.0	62.0	61.0	61.0	64.0	63.0	65.0	66.0
10:15 AM	35.0	66.0	67.0	65.0	64.0	66.0	63.0	62.0	61.0	60.0	64.0	64.0	65.0	66.0
10:30 AM	30.0	64.0	64.0	64.0	65.0	67.0	63.0	61.0	62.0	60.0	65.0	65.0	66.0	68.0
10:45 AM	34.0	64.0	66.0	65.0	63.0	65.0	63.0	62.0	64.0	60.0	67.0	64.0	65.0	66.0
11:00 AM	31.0	64.0	67.0	66.0	65.0	66.0	65.0	64.0	62.0	61.0	65.0	64.0	66.0	69.0
11:15 AM	31.0	65.0	66.0	65.0	65.0	65.0	65.0	62.0	62.0	60.0	65.0	64.0	66.0	67.0
11:30 AM	31.0	66.0	66.0	65.0	63.0	64.0	63.0	61.0	61.0	60.0	64.0	64.0	66.0	67.0
11:45 AM	31.0	67.0	68.0	67.0	65.0	66.0	66.0	65.0	64.0	62.0	67.0	65.0	67.0	69.0
12:00 PM	29.0	65.0	68.0	66.0	66.0	67.0	64.0	63.0	64.0	62.0	66.0	64.0	65.0	68.0
12:15 PM	34.0	64.0	67.0	67.0	66.0	67.0	65.0	62.0	63.0	62.0	64.0	63.0	66.0	67.0
12:30 PM	33.0	63.0	65.0	66.0	65.0	66.0	64.0	63.0	63.0	62.0	64.0	63.0	66.0	69.0
12:45 PM	32.0	65.0	66.0	67.0	65.0	66.0	64.0	62.0	62.0	61.0	63.0	62.0	65.0	68.0
1:00 PM	33.0	63.0	66.0	66.0	65.0	67.0	66.0	64.0	63.0	61.0	64.0	64.0	65.0	67.0
1:15 PM	35.0	63.0	65.0	66.0	67.0	68.0	67.0	66.0	63.0	62.0	64.0	64.0	65.0	68.0
1:30 PM	33.0	64.0	66.0	65.0	64.0	65.0	64.0	62.0	61.0	59.0	64.0	61.0	65.0	66.0
1:45 PM	29.0	65.0	65.0	66.0	65.0	65.0	64.0	62.0	62.0	61.0	63.0	63.0	65.0	67.0
2:00 PM	29.0	65.0	67.0	66.0	65.0	66.0	65.0	63.0	62.0	62.0	65.0	63.0	66.0	67.0
2:15 PM	28.0	66.0	66.0	66.0	65.0	67.0	67.0	63.0	63.0	61.0	66.0	63.0	66.0	69.0
2:30 PM	26.0	65.0	67.0	67.0	65.0	65.0	64.0	62.0	63.0	61.0	63.0	63.0	65.0	67.0
2:45 PM	31.0	67.0	69.0	67.0	64.0	67.0	66.0	65.0	64.0	61.0	63.0	63.0	65.0	67.0
3:00 PM	33.0	66.0	68.0	68.0	66.0	68.0	65.0	64.0	62.0	62.0	66.0	65.0	67.0	71.0
3:15 PM	32.0	63.0	67.0	65.0	65.0	65.0	64.0	62.0	62.0	61.0	62.0	63.0	65.0	68.0
3:30 PM	32.0	65.0	67.0	67.0	65.0	67.0	65.0	63.0	63.0	63.0	66.0	64.0	65.0	67.0
3:45 PM	30.0	64.0	66.0	67.0	66.0	65.0	64.0	63.0	63.0	63.0	64.0	65.0	66.0	69.0
4:00 PM	32.0	64.0	65.0	67.0	65.0	67.0	66.0	63.0	63.0	62.0	65.0	64.0	66.0	69.0
4:15 PM	31.0	64.0	66.0	64.0	64.0	66.0	64.0	61.0	62.0	59.0	66.0	64.0	66.0	68.0
4:30 PM	33.0	62.0	64.0	65.0	65.0	66.0	64.0	62.0	62.0	60.0	62.0	61.0	65.0	68.0
4:45 PM	34.0	65.0	68.0	67.0	67.0	67.0	65.0	63.0	63.0	61.0	62.0	61.0	65.0	67.0
5:00 PM	26.0	64.0	66.0	65.0	65.0	68.0	66.0	64.0	63.0	61.0	62.0	61.0	64.0	66.0
5:15 PM	30.0	64.0	65.0	64.0	63.0	64.0	62.0	61.0	61.0	59.0	62.0	60.0	62.0	63.0
5:30 PM	33.0	65.0	66.0	65.0	64.0	64.0	61.0	61.0	61.0	60.0	63.0	60.0	60.0	57.0
5:45 PM	32.0	63.0	64.0	64.0	63.0	64.0	62.0	60.0	59.0	59.0	63.0	60.0	60.0	60.0
6:00 PM	24.0	64.0	66.0	66.0	66.0	65.0	63.0	62.0	61.0	59.0	63.0	61.0	63.0	65.0
6:15 PM	32.0	63.0	66.0	65.0	64.0	65.0	64.0	62.0	62.0	60.0	61.0	61.0	64.0	66.0
6:30 PM	34.0	63.0	66.0	66.0	65.0	66.0	63.0	62.0	62.0	62.0	64.0	63.0	66.0	68.0
6:45 PM	32.0	65.0	68.0	68.0	66.0	68.0	67.0	65.0	64.0	63.0	67.0	64.0	67.0	68.0
7:00 PM	33.0	66.0	67.0	68.0	66.0	66.0	65.0	65.0	64.0	64.0	66.0	65.0	67.0	68.0
7:15 PM	29.0	65.0	66.0	67.0	66.0	66.0	64.0	64.0	62.0	61.0	64.0	61.0	64.0	69.0
7:30 PM	28.0	63.0	67.0	65.0	64.0	65.0	63.0	62.0	61.0	61.0	65.0	64.0	64.0	69.0
7:45 PM	33.0	63.0	65.0	66.0	66.0	66.0	64.0	64.0	62.0	62.0	64.0	64.0	66.0	68.0
8:00 PM	32.0	63.0	62.0	65.0	65.0	66.0	62.0	61.0	60.0	62.0	65.0	67.0	67.0	71.0
8:15 PM	32.0	63.0	65.0	65.0	64.0	65.0	65.0	62.0	61.0	63.0	65.0	65.0	66.0	65.0
8:30 PM	30.0	65.0	65.0	67.0	66.0	67.0	66.0	65.0	64.0	63.0	66.0	66.0	67.0	70.0
8:45 PM	29.0	64.0	65.0	65.0	66.0	68.0	67.0	65.0	63.0	63.0	65.0	65.0	66.0	69.0
9:00 PM	28.0	63.0	65.0	65.0	62.0	64.0	64.0	64.0	62.0	63.0	65.0	64.0	66.0	68.0
9:15 PM	28.0	63.0	63.0	66.0	65.0	65.0	64.0	62.0	61.0	63.0	62.0	62.0	67.0	70.0
9:30 PM	28.0	65.0	64.0	69.0	66.0	65.0	61.0	65.0	63.0	63.0	66.0	64.0	64.0	68.0
9:45 PM	29.0	61.0	62.0	64.0	63.0	62.0	63.0	62.0	64.0	62.0	60.0	61.0	62.0	66.0
10:00 PM	29.0	61.0	62.0	64.0	63.0	64.0	63.0	62.0	61.0	60.0	60.0	60.0	62.0	66.0
10:15 PM	31.0	62.0	62.0	67.0	65.0	65.0	64.0	62.0	62.0	61.0	59.0	60.0	61.0	64.0
10:30 PM	29.0	64.0	64.0	67.0	67.0	69.0	68.0	66.0	65.0	62.0	60.0	62.0	64.0	66.0
10:45 PM	32.0	61.0	63.0	64.0	62.0	63.0	63.0	62.0	61.0	59.0	62.0	64.0	63.0	66.0
11:00 PM	34.0	63.0	63.0	64.0	66.0	66.0	62.0	63.0	63.0	63.0	62.0	63.0	63.0	64.0
11:15 PM	33.0	61.0	62.0	63.0	62.0	62.0	64.0	61.0	62.0	63.0	60.0	59.0	61.0	64.0
11:30 PM	33.0	60.0	60.0	63.0	61.0	62.0	61.0	60.0	61.0	60.0	58.0	58.0	60.0	63.0
11:45 PM	32.0	61.0	61.0	61.0	61.0	61.0	60.0	60.0	60.0	60.0	58.0	58.0	59.0	61.0

Green	Greater than 55 mph
Yellow	45 to 55 mph
Orange	35 to 45 mph
Red	Less than 35 mph

Figure 45: Speed Contours, I-680 Control Corridor Southbound, After Study (2018)

Target Time	Sunvalley Blvd Off-Ramp to Sunvalley Blvd On-Ramp	Sunvalley Blvd Off-Ramp to Gregory Ln/Monument Blvd Off-Ramp	Gregory Ln/Monument Blvd Off-Ramp to CA-242 On-Ramp	CA-242 On-Ramp to Monument Blvd On-Ramp	Monument Blvd On-Ramp to Main St Off-Ramp	Main St Off-Ramp to Main St On-Ramp	Main St On-Ramp to Treat Blvd On-Ramp	Treat Blvd On-Ramp to San Luis Rd Off-Ramp	San Luis Rd Off-Ramp to San Luis Rd On-Ramp	San Luis Rd On-Ramp to CA-24 Off-Ramp	CA-24 Off-Ramp to Ygnacio Valley Rd On-Ramp	Ygnacio Valley Rd On-Ramp to Olympic Blvd Off-Ramp	Olympic Blvd Off-Ramp to CA-24 On-Ramp	CA-24 On-Ramp to Olympic Blvd On-Ramp
	80th Percentile Travel Time Per Day													
12:00 AM	36.0	65.0	66.0	68.0	65.0	65.0	61.0	68.0	67.0	64.0	65.0	66.0	66.0	67.0
12:15 AM	33.0	61.0	60.0	61.0	61.0	60.0	59.0	58.0	58.0	57.0	58.0	58.0	59.0	60.0
12:30 AM	24.0	62.0	62.0	64.0	63.0	63.0	60.0	63.0	62.0	62.0	63.0	61.0	62.0	63.0
12:45 AM	19.0	66.0	66.0	70.0	66.0	67.0	63.0	69.0	67.0	65.0	66.0	67.0	68.0	68.0
1:00 AM	16.0	64.0	66.0	68.0	65.0	66.0	65.0	69.0	68.0	64.0	65.0	67.0	66.0	67.0
1:15 AM	16.0	65.0	66.0	67.0	64.0	66.0	59.0	68.0	66.0	64.0	65.0	69.0	65.0	66.0
1:30 AM	15.0	66.0	66.0	68.0	64.0	64.0	62.0	69.0	68.0	65.0	66.0	68.0	68.0	67.0
1:45 AM	17.0	65.0	66.0	67.0	65.0	65.0	63.0	69.0	66.0	64.0	66.0	69.0	65.0	68.0
2:00 AM	26.0	66.0	66.0	67.0	66.0	65.0	61.0	69.0	67.0	65.0	66.0	67.0	67.0	68.0
2:15 AM	32.0	65.0	65.0	66.0	65.0	66.0	64.0	67.0	66.0	65.0	65.0	66.0	65.0	66.0
2:30 AM	32.0	66.0	66.0	67.0	64.0	65.0	62.0	69.0	68.0	65.0	66.0	68.0	65.0	67.0
2:45 AM	32.0	64.0	65.0	67.0	63.0	64.0	62.0	68.0	66.0	63.0	66.0	67.0	65.0	67.0
3:00 AM	40.0	64.0	64.0	67.0	66.0	66.0	63.0	69.0	67.0	65.0	66.0	67.0	68.0	68.0
3:15 AM	44.0	65.0	65.0	68.0	67.0	66.0	67.0	69.0	68.0	65.0	66.0	68.0	67.0	68.0
3:30 AM	46.0	67.0	66.0	68.0	65.0	64.0	69.0	69.0	67.0	65.0	65.0	66.0	67.0	69.0
3:45 AM	35.0	65.0	65.0	69.0	66.0	65.0	64.0	68.0	67.0	64.0	65.0	67.0	67.0	68.0
4:00 AM	36.0	70.0	68.0	71.0	70.0	70.0	70.0	71.0	70.0	68.0	67.0	68.0	69.0	70.0
4:15 AM	37.0	68.0	68.0	70.0	70.0	70.0	70.0	71.0	69.0	67.0	69.0	68.0	70.0	71.0
4:30 AM	38.0	67.0	68.0	70.0	69.0	69.0	69.0	71.0	68.0	66.0	68.0	68.0	68.0	70.0
4:45 AM	37.0	68.0	69.0	70.0	71.0	71.0	70.0	70.0	68.0	66.0	68.0	68.0	70.0	72.0
5:00 AM	38.0	69.0	70.0	70.0	71.0	73.0	70.0	71.0	68.0	68.0	69.0	69.0	69.0	71.0
5:15 AM	38.0	69.0	70.0	68.0	67.0	67.0	65.0	66.0	65.0	64.0	68.0	67.0	69.0	70.0
5:30 AM	37.0	68.0	68.0	65.0	65.0	64.0	61.0	61.0	59.0	60.0	65.0	65.0	68.0	69.0
5:45 AM	34.0	66.0	66.0	61.0	60.0	59.0	55.0	48.0	49.0	57.0	63.0	65.0	67.0	70.0
6:00 AM	32.0	64.0	64.0	56.0	40.0	31.0	30.0	30.0	39.0	52.0	60.0	62.0	64.0	67.0
6:15 AM	32.0	63.0	58.0	37.0	25.0	23.0	24.0	26.0	34.0	49.0	56.0	61.0	63.0	66.0
6:30 AM	35.0	61.0	43.0	24.0	20.0	21.0	22.0	25.0	31.0	46.0	54.0	58.0	62.0	64.0
6:45 AM	33.0	60.0	47.0	22.0	18.0	20.0	21.0	22.0	29.0	35.0	47.0	55.0	60.0	62.0
7:00 AM	27.0	62.0	47.0	24.0	17.0	18.0	19.0	20.0	24.0	29.0	39.0	50.0	57.0	61.0
7:15 AM	27.0	61.0	42.0	19.0	15.0	15.0	16.0	17.0	20.0	25.0	36.0	50.0	56.0	54.0
7:30 AM	26.0	60.0	33.0	17.0	13.0	14.0	14.0	14.0	18.0	25.0	37.0	53.0	54.0	55.0
7:45 AM	26.0	60.0	37.0	17.0	12.0	14.0	15.0	16.0	18.0	25.0	42.0	54.0	57.0	52.0
8:00 AM	30.0	61.0	37.0	19.0	16.0	18.0	19.0	19.0	19.0	24.0	41.0	51.0	54.0	51.0
8:15 AM	35.0	61.0	30.0	23.0	16.0	19.0	17.0	18.0	20.0	26.0	30.0	48.0	53.0	50.0
8:30 AM	32.0	61.0	37.0	21.0	20.0	22.0	20.0	20.0	22.0	26.0	30.0	46.0	51.0	47.0
8:45 AM	28.0	62.0	37.0	21.0	21.0	22.0	22.0	21.0	24.0	27.0	26.0	42.0	50.0	30.0
9:00 AM	28.0	64.0	58.0	38.0	40.0	33.0	26.0	25.0	26.0	32.0	29.0	41.0	49.0	48.0
9:15 AM	32.0	67.0	67.0	64.0	59.0	49.0	35.0	34.0	37.0	46.0	45.0	50.0	54.0	52.0
9:30 AM	34.0	65.0	66.0	64.0	61.0	61.0	60.0	58.0	56.0	56.0	56.0	55.0	60.0	57.0
9:45 AM	36.0	64.0	66.0	64.0	62.0	63.0	60.0	59.0	58.0	57.0	59.0	58.0	61.0	63.0
10:00 AM	37.0	67.0	66.0	67.0	64.0	65.0	62.0	61.0	54.0	58.0	59.0	60.0	62.0	65.0
10:15 AM	36.0	64.0	65.0	65.0	64.0	63.0	62.0	60.0	59.0	59.0	60.0	62.0	64.0	66.0
10:30 AM	39.0	64.0	66.0	65.0	64.0	65.0	62.0	61.0	61.0	60.0	62.0	63.0	65.0	68.0
10:45 AM	35.0	65.0	65.0	66.0	67.0	66.0	64.0	64.0	63.0	62.0	65.0	64.0	66.0	69.0
11:00 AM	35.0	66.0	67.0	68.0	68.0	66.0	63.0	62.0	63.0	60.0	63.0	62.0	65.0	69.0
11:15 AM	38.0	66.0	66.0	67.0	66.0	66.0	63.0	63.0	63.0	62.0	62.0	61.0	64.0	67.0
11:30 AM	35.0	65.0	66.0	66.0	64.0	63.0	63.0	62.0	61.0	60.0	62.0	61.0	65.0	68.0
11:45 AM	37.0	65.0	66.0	66.0	64.0	64.0	62.0	63.0	63.0	61.0	65.0	62.0	67.0	69.0
12:00 PM	37.0	64.0	66.0	67.0	65.0	66.0	64.0	64.0	62.0	62.0	64.0	63.0	66.0	68.0
12:15 PM	38.0	65.0	66.0	66.0	64.0	64.0	63.0	63.0	62.0	61.0	63.0	62.0	66.0	67.0
12:30 PM	36.0	65.0	65.0	67.0	67.0	64.0	63.0	63.0	63.0	61.0	64.0	63.0	65.0	68.0
12:45 PM	37.0	66.0	67.0	67.0	64.0	64.0	65.0	63.0	64.0	63.0	64.0	63.0	66.0	68.0
1:00 PM	38.0	66.0	68.0	67.0	66.0	67.0	65.0	64.0	65.0	62.0	65.0	64.0	67.0	69.0
1:15 PM	37.0	63.0	65.0	66.0	64.0	64.0	63.0	63.0	62.0	62.0	62.0	63.0	67.0	69.0
1:30 PM	36.0	63.0	65.0	65.0	64.0	66.0	64.0	65.0	63.0	61.0	63.0	63.0	68.0	68.0
1:45 PM	37.0	67.0	67.0	67.0	66.0	66.0	62.0	63.0	63.0	62.0	64.0	64.0	66.0	68.0
2:00 PM	37.0	66.0	67.0	67.0	65.0	66.0	64.0	63.0	62.0	62.0	65.0	63.0	67.0	69.0
2:15 PM	36.0	65.0	65.0	64.0	62.0	64.0	62.0	62.0	61.0	59.0	62.0	63.0	66.0	68.0
2:30 PM	38.0	64.0	66.0	65.0	65.0	64.0	61.0	61.0	59.0	59.0	63.0	61.0	66.0	67.0
2:45 PM	37.0	63.0	64.0	66.0	65.0	66.0	62.0	62.0	61.0	61.0	64.0	64.0	66.0	68.0
3:00 PM	38.0	65.0	66.0	66.0	67.0	67.0	65.0	64.0	62.0	61.0	65.0	63.0	66.0	69.0
3:15 PM	38.0	65.0	65.0	65.0	64.0	65.0	63.0	62.0	60.0	59.0	63.0	60.0	65.0	69.0
3:30 PM	39.0	63.0	65.0	67.0	67.0	67.0	63.0	63.0	61.0	60.0	63.0	60.0	66.0	69.0
3:45 PM	39.0	64.0	64.0	65.0	65.0	64.0	62.0	63.0	59.0	59.0	63.0	59.0	66.0	68.0
4:00 PM	38.0	65.0	66.0	66.0	64.0	64.0	63.0	61.0	61.0	61.0	63.0	61.0	66.0	68.0
4:15 PM	37.0	65.0	67.0	67.0	65.0	66.0	64.0	62.0	62.0	60.0	60.0	59.0	63.0	68.0
4:30 PM	37.0	63.0	65.0	65.0	64.0	65.0	64.0	62.0	62.0	60.0	61.0	59.0	64.0	66.0
4:45 PM	33.0	63.0	64.0	66.0	64.0	64.0	61.0	60.0	59.0	60.0	61.0	59.0	63.0	67.0
5:00 PM	30.0	63.0	65.0	65.0	63.0	63.0	61.0	59.0	57.0	57.0	58.0	57.0	62.0	65.0
5:15 PM	31.0	62.0	66.0	64.0	62.0	63.0	60.0	59.0	57.0	55.0	54.0	56.0	61.0	63.0
5:30 PM	31.0	61.0	63.0	64.0	62.0	62.0	60.0	56.0	53.0	53.0	49.0	51.0	59.0	60.0
5:45 PM	29.0	65.0	66.0	65.0	64.0	63.0	60.0	58.0	57.0	56.0	51.0	52.0	60.0	48.0
6:00 PM	27.0	62.0	65.0	67.0	63.0	66.0	63.0	62.0	61.0	61.0	58.0	56.0	62.0	61.0
6:15 PM	30.0	64.0	66.0	64.0	63.0	64.0	62.0	60.0	61.0	59.0	63.0	61.0	63.0	65.0
6:30 PM	32.0	66.0	68.0	68.0	68.0	68.0	65.0	63.0	63.0	62.0	64.0	60.0	64.0	68.0
6:45 PM	33.0	66.0	65.0	67.0	66.0	67.0	65.0	64.0	62.0	62.0	65.0	62.0	67.0	68.0
7:00 PM	33.0	66.0	66.0	68.0	65.0	66.0	65.0	65.0	63.0	64.0	64.0	61.0	67.0	68.0
7:15 PM	32.0	66.0	67.0	68.0	68.0	68.0	66.0	65.0	63.0	64.0	65.0	64.0	68.0	71.0
7:30 PM	32.0	67.0	67.0	69.0	67.0	69.0	66.0	67.0	65.0	64.0	66.0	64.0	69.0	71.0
7:45 PM	36.0	67.0	68.0	69.0	67.0	66.0	67.0	66.0	64.0	63.0	65.0	64.0	67.0	69.0
8:00 PM	36.0	66.0	66.0	68.0	65.0	68.0	66.0	67.0	63.0	64.0	65.0	67.0	67.0	70.0
8:15 PM	34.0	65.0	67.0	68.0	65.0	68.0	65.0	68.0	67.0	65.0	67.0	67.0	68.0	71.0
8:30 PM	35.0	66.0	67.0	70.0	67.0	70.0	66.0	70.0	67.0	65.0	68.0	68.0	69.0	70.0
8:45 PM	34.0	66.0	65.0	69.0	65.0	67.0	64.0	69.0	66.0	64.0	66.0	67.0	69.0	70.0
9:00 PM	35.0	64.0	66.0	68.0	68.0	69.0	68.0	69.0	67.0	66.0	67.0	65.0	68.0	71.0
9:15 PM	33.0	64.0	65.0	68.0	67.0	69.0	69.0	68.0	66.0	65.0	67.0	67.0	69.0	70.0
9:30 PM	32.0	63.0	65.0	67.0	67.0	69.0	68.0	69.0	67.0	65.0	66.0	67.0	67.0	69.0
9:45 PM	30.0	64.0	65.0	69.0	69.0	70.0	68.0	69.0	68.0	65.0	66.0	67.0	68.0	71.0
10:00 PM	31.0	64.0	66.0	70.0	68.0	70.0	69.0	70.0	67.0	66.0	67.0	66.0	69.0	70.0
10:15 PM	34.0	65.0	66.0	69.0	66.0	67.0	63.0	70.0	69.0	67.0	68.0	68.0	68.0	69.0
10:30 PM	36.0	65.0	67.0	68.0	66.0	67.0	64.0	70.0	68.0	66.0	68.0	67.0	68.0	68.0
10:45 PM	35.0	65.0	66.0	68.0	66.0	67.0	64.0	70.0	68.0	65.0	67.0	68.0	68.0	69.0
11:00 PM	35.0	65.0	65.0	69.0	66.0	66.0	64.0	69.0	67.0	64.0	66.0	67.0	66.0	67.0
11:15 PM	35.0	64.0	65.0	68.0	65.0	65.0	62.0	69.0	67.0	65.0	66.0	67.0	67.0	68.0
11:30 PM	37.0	65.0	65.0	68.0	65.0	66.0	64.0	68.0	67.0	65.0	65.0	66.0	67.0	69.0
11:45 PM	37.0	65.0	66.0	68.0	67.0	66.0	64.0	69.0	67.0	65.0	65.0	67.0	67.0	68.0

Green	Greater than 55 mph
Yellow	45 to 55 mph
Orange	35 to 45 mph
Red	Less than 35 mph

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