Freeway Corridor Management Summary: Executive Summary

San Francisco's freeway network is facing a critical problem: more people than ever are using US 101 and I-280 to travel to, from, and through the city.

Delays and lack of reliability on our freeways result in lost time and longer commutes. And congestion is expected to increase: by 2040, there will be more than 100,000 additional daily trips between San Francisco and the South Bay.

Left unaddressed, congestion on the freeways will continue to grow, exacerbating the delays, lack of reliability, and environmental impacts we see today.

The Transportation Authority has conducted a study to understand how we can address this growing challenge in the near-term. The Freeway Corridor Management Study Phase 2 focuses on addressing congestion while achieving the following goals:

- **Move people efficiently:** We need to get more travelers to their destinations as quickly and reliably as possible in the existing freeway footprint.
- **Increase trip reliability:** More reliable travel times will help everyone, from parents picking up their children from school to commuters who need to get to work on time.
- **Enhance travel choices:** Better transit and incentives to carpool give commuters convenient new travel options.
- **Contribute to a regional network:** San Francisco's freeway management strategies will be coordinated with similar projects in San Mateo and across the region.
- **Reduce emissions:** Moving more people in the same or fewer vehicles will help achieve our climate goals as our population grows.
- **Support community well-being:** We must ensure that any changes to freeway operations support equity and safety in nearby neighborhoods.

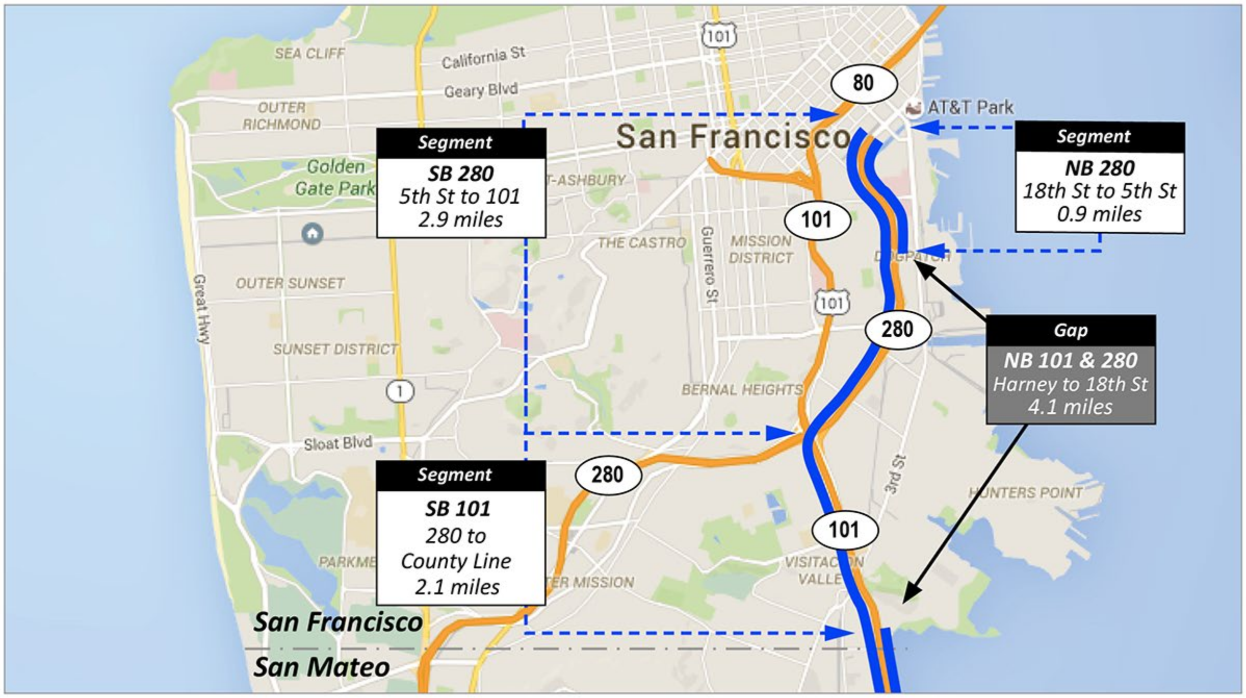
Seeking Solutions with Managed Lanes

Building off of these goals and guidelines, the study team focused this study on implementation of managed lanes, broadly referred to as any lanes on a freeway reserved for carpools or vehicles that are charged for access (these lanes are often known as "express lanes").

Without any changes to the current operation of the freeways in San Francisco, buses and carpools will continue to be stuck in the same traffic as all other vehicles, providing travelers with no incentive to ride transit or carpool. Managed lanes could give transit and carpools a faster ride, incentivizing more efficient trips.

Managed Lane Configuration

Given the existing configuration of our freeways, carpool or express lanes could be implemented in the below segments:



Southbound lanes: the existing configuration of the I-280 and US 101 freeways allows for the creation of a continuous lane by converting the left-most existing general purpose lane into a managed lane. A carpool or Express Lane could operate along I-280 between the intersection of 5th and King Streets and US 101, continuing through the interchange to US 101 into San Mateo County, covering a distance of about five miles in San Francisco proper. This extension would be the northern end of a 65-mile managed lane from San Francisco to Morgan Hill.

Northbound lanes: because I-280 exits from the right side of northbound US 101, any carpool or Express lanes entering San Francisco from San Mateo county will likely end at or near the county line. However, the study identified an opportunity to provide priority for northbound carpools and buses for approximately one mile along I-280N headed into South of Market, from about 18th Street to 5th Street.

This study evaluates four managed lane options for a 2020 timeframe:

1) **No Build: The configuration of freeways remains as it is today.**
The study found that under this scenario, congestion continues to get worse, with some bottlenecks resulting in an additional 2 to 5 minutes of travel time over existing conditions. Despite this, there remains no incentive to use transit or carpool in the corridor, as both buses and carpools remain subject to these increasing delays.

2) **HOV2+: High Occupancy Vehicle (carpool) with a two-person minimum requirement.**
The study found that this option is not expected to provide travel time savings to transit riders and carpools and should not advance to further study.

3) **HOV3+: High Occupancy Vehicle (carpool) with a three-person minimum requirement.**

The study found that this option creates substantial additional congestion in the corridor, reduces person throughput, and should not advance to further study.

4) **HOT3+: Express Lane with a three-person minimum carpool requirement.** In this scenario, transit and carpools of three or more can access the lane at no cost. A demand-based, variable toll will be available to others who may pay to access the lane.

   The study found that this option could advance the goals of this study and warrants more detailed evaluation in subsequent study phases.

   In addition, important public policy concerns related to the equity impacts of express lanes should be considered, studied further, and mitigated.

1. Introduction

Congestion on San Francisco's freeways is bad and getting worse. The San Francisco County Transportation Authority's latest congestion monitoring data identifies that average speeds on San Francisco's most trafficked freeways, I-280 and US 101, have dropped each year since 2009. Delays and the lack of reliability inherent in travel on roadways that are at or over capacity results in lost time by all travelers that use the freeways, reduced business efficiency from slower deliveries, and environmental and livability impacts on surrounding neighborhoods from traffic diverted to local streets and increased pollution from stop and go traffic.

Looking ahead, travel is projected to continue to grow on major freeway corridors through 2040. Based on the 2017 San Francisco Transportation Plan, between San Francisco and San Mateo Counties alone, over 100,000 additional daily trips are forecast. This is equivalent to one full bus every two minutes between the two counties. Left unaddressed, congestion on the freeways and crowding on transit will continue to grow, exacerbating the delays, lack of reliability, and environmental impacts we see today.

1.1 Previous studies

The 2013 Countywide Transportation Plan first identified the need for a comprehensive review of strategies to more effectively utilize San Francisco's existing freeway infrastructure, and included a recommendation to set a vision for managing the city's freeway network. Work on this recommendation began in 2014, resulting in the adoption by the SFCTA board of the Freeway Corridor Management Study Phase 1 report in 2015. The Phase 1 report inventories potential strategies for increasing the efficiency and functionality of freeways to provide congestion relief along with proposing a set of goals by which these improvements should be evaluated. These goals, which form the basis of the evaluation in this Phase 2 report, are summarized below and detailed in Appendix A:

- **Move people efficiently:** We need to get more travelers to their destinations as quickly and reliably as possible in the existing freeway footprint.
- **Increase trip reliability:** More reliable travel times will help everyone, from parents picking up their children from school to commuters who need to get to work on time.

- **Enhance travel choices:** Better transit and incentives to carpool give commuters convenient new travel options.
- **Contribute to a regional network:** San Francisco's freeway management strategies will be coordinated with similar projects in San Mateo and across the region.
- **Reduce emissions:** Moving more people in the same or fewer vehicles will help achieve our climate goals as our population grows.
- **Support community well-being:** We must ensure that any changes to freeway operations support equity and safety in nearby neighborhoods.

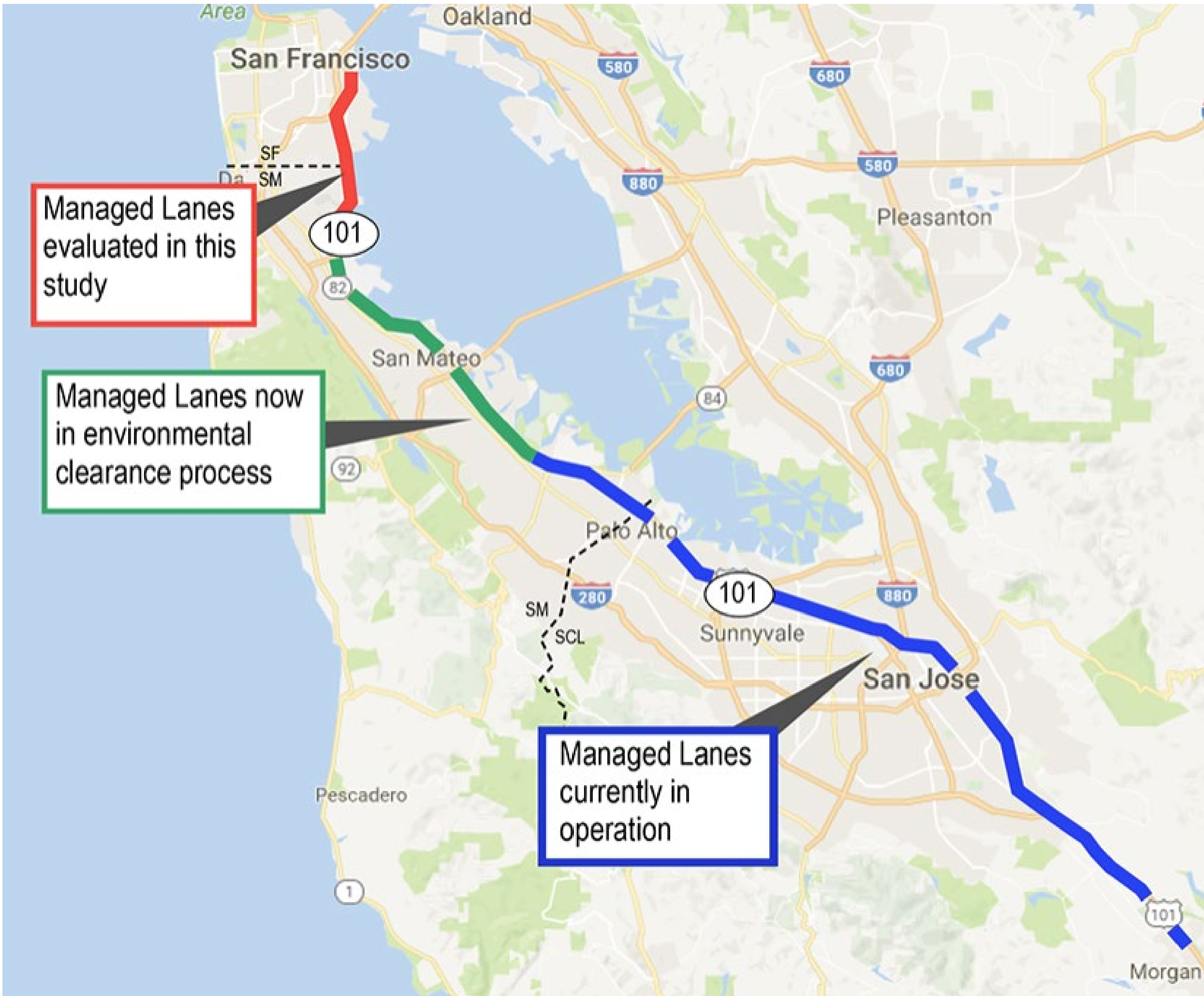
1.2 Freeway Corridor Management Study Phase 2 Purpose

This study, the Freeway Corridor Management Study Phase 2, aims to identify near- to medium-term improvements that will enable more reliable and efficient access between San Francisco and the region via San Francisco's US-101/I-280 North extension corridor. These improvements would complement and support major transit investments such as the electrification of Caltrain and its extension to the Salesforce Transit Center. This study was guided by the goals of the Phase 1 report (summarized in Section 1.2), and focuses on strategies that move more people in the same or fewer number of vehicles, and within the same footprint of today's freeways.

Without any changes to the current operation of the freeways in San Francisco, buses and carpools will continue to be stuck in the same traffic as all other vehicles, providing travelers with no incentive to ride transit or carpool. San Francisco, along with Napa, are the only two counties in the nine-county Bay Area that do not provide any preferential treatment for transit or carpools on its freeways. Given this, the study team for Phase 2 – including project partners at Caltrans (the owner of the freeway facilities), the San Mateo County Transportation Authority, the San Mateo City/County Association of Governments, and the San Francisco Municipal Transit Agency – have collaborated to conduct a feasibility-level analysis of options for extending managed lanes, broadly referred to as any lanes on a freeway set aside from general-purpose lanes, either by occupancy requirements, pricing or access limitations (i.e. carpool or HOV and/or "Express" or HOT lanes), from their current planned endpoint near San Francisco International Airport to downtown San Francisco.

[Sidebar - The San Mateo County Transportation Authority is currently seeking environmental clearance for a project that proposes to build an express lane in both directions on US-101 in San Mateo County. The express lanes would connect with existing carpool lanes which would be converted into express lanes themselves, creating new continuous express lanes that extend from I-380 in San Bruno to San Antonio Road in Mountain View. See http://www.dot.ca.gov/d4/101managedlanes/ for more details.]

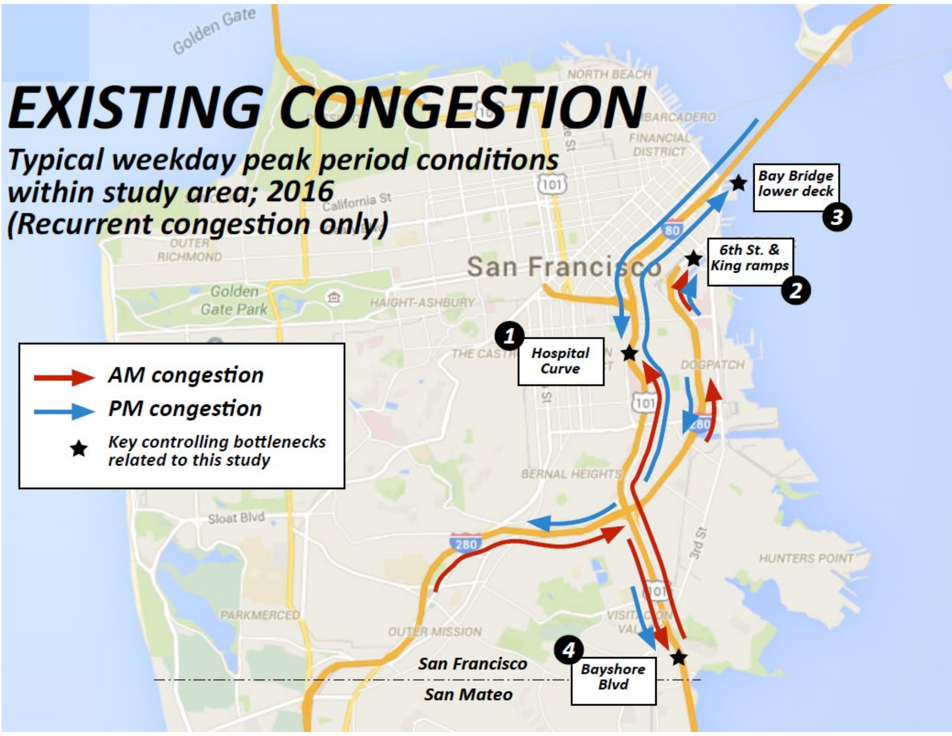
This focus is also in alignment with state SB 1 Congested Corridors Program priorities and MTC/BATA regional express lane network plans, both of which identified US 101 as a high priority corridor for multi-jurisdictional solutions to congestion. San Francisco wishes to support regional efforts to create a continuous transit and carpool priority lane along the US 101 corridor, creating a more reliable way to travel between downtown San Francisco, downtown San Jose, and points in between that may not be easily accessible from Caltrain's commuter rail service. Santa Clara, San Mateo and San Francisco counties coordinated with Caltrans to update the 101 Corridor System Management Plan to provide a tri-county vision for a continuous managed facility with complementary transit and mobility strategies up and down the Peninsula. Figure 1 shows the status of managed lanes efforts in the three counties.

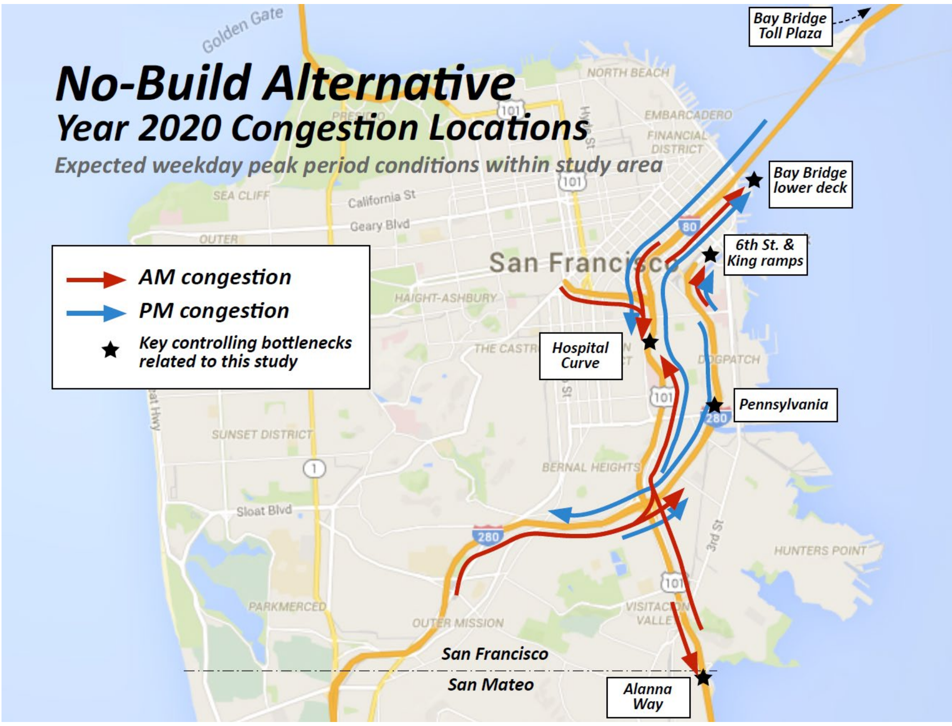


The results of this study represent an early understanding and recommendation on feasible managed lane options that could be implemented in the near- to medium term. Like all feasibility studies, this analysis is intended to provide a high-level investigation into the viability of proposed concepts and suggest promising alternatives for further study. The level of detail generated at this stage is commensurate with the best data currently available and the understanding that more comprehensive and detailed multi-modal analyses need to be conducted in subsequent development phases of the project, including further alternative development and scoping, traffic analyses, environmental review, and final design. The intent at this stage is to identify conceptual alternatives that can achieve the project goals identified during Phase 1, and to provide a preliminary assessment of their feasibility from both a physical, operational and public policy perspective.

2. Existing Conditions and Needs Assessment

To begin, the study team conducted a review of the operational conditions and physical geometry of the freeway network in order to identify opportunities to quickly and cost-effectively address congestion and create a more reliable connection from the county line to downtown. Figures 2 and 3 show existing congestion and bottlenecks within the study area in the year 2016 as well as projected congestion and bottlenecks in future year 2020.





As shown in Figures 2 and 3, congestion continues to worsen as travel grows in the coridor. In 2020, the locations of bottlenecks will largely remain the same, though the delay created by each bottleneck will worsen, resulting in longer queues of traffic building at each location.

Early on, the study team assessed the potential to develop managed lanes on US 101 through to the San Francisco-Oakland Bay Bridge, but determined that several operational and geometric constraints pose significant challenges to utilizing US 101 north of the US 101/I-280 interchange. These included:

- Volume: Heavy traffic volumes on the Bay Bridge throughout the day and at peak periods create queues extending to and onto I-280 to the south on US 101 and backing up to the SF-Oakland Bay Bridge to the north/east;
- Capacity: Though there are generally four lanes in each direction on US 101, only three of these lanes continue through the US 101/I-280 interchange. The structural design of this interchange also severely limits any expansion opportunity without completely reconstructing the interchange at high impact;[1]
- Configuration: Exits from both the right and left side of the facility that effectively prevent use of existing left lane as a carpool or express lane. Only a single lane of US 101 continues without exiting on either the right of left side between the Bay Bridge and the San Francisco/San Mateo county line.

[1] Existing supports for the northbound connector from I-280 to US 101 straddle the three-lane cross-section of US 101 at the interchange. Thus, widening that portion of the freeway would likely require reconstructing the entire connector.

- Jurisdiction: Caltrans owns all freeways, and the Metropolitan Transportation Commission has jurisdiction over I-80 east of the Fifth Street on-ramp, so any potential project would need to be studied in close partnership with multiple agencies to properly assess costs, benefits and impacts.

For these reasons, the study team concluded that the I-280 extension provides the more feasible initial managed lanes opportunity. The question of how to bypass congestion on US 101 north of the US 101/I-280 interchange and on the approach to the Bay Bridge must still be addressed, and along with studies of I-280 west of US 101, will be advanced in the San Francisco Streets and Freeways Study, a component of ConnectSF, San Francisco's ongoing long-range transportation planning program.

Operationally, I-280 northbound from the interchange to its terminus at 5th and King Streets near AT&T Park and the Caltrain station represents a good opportunity to introduce a managed lane. It is a newer freeway with lower traffic volumes than US 101, previously included an HOV lane (prior to the 1989 Loma Prieta earthquake) and has the potential to be restriped to provide a carpool or express lane without significant impacts on existing traffic. While the I-280 facility west of US 101 is congested, these delays are primarily caused by the connection to northbound US 101 and the controlling bottleneck on Interstate 80 at the approach to the San Francisco-Oakland Bay Bridge.

In addition to the physical characteristics, the study team focused on understanding the current operations of both the US 101 and I-280 freeways - where and when is congestion present, what delay does it create, and what is its cause? These performance characteristics are described in the FCMS Existing Conditions Report (Appendix B), and summarized in Figures 2 and 3 above. This portion of the study included a review of traffic conditions in northern San Mateo county as well, resulting in coordination with the San Mateo County Transportation Authority and C/CAG to identify congestion and address ways to fill a gap between the end of San Mateo's Managed Lane project at I-380 and the San Francisco/San Mateo county line.

[Sidebar - Why Not Widening?

As opportunities to address congestion within the project limits took shape, the team began to outline the set of potential solutions for analysis in the Study. In line with existing San Francisco policy meant to discourage personal car use and protect San Francisco's neighborhoods, designs that included significant expansion of freeway capacity were not advanced. Policy 3.1 of the Transportation Element in the San Francisco General Plan reads:

> "The existing capacity of the bridges, highways and freeways entering the city should not be increased for single-occupant vehicles, and should be reduced where possible. Changes, retrofits or replacements to existing bridges and highways should include dedicated priority for high-occupancy vehicles and transit, and all bridges should feature access for bicyclists and pedestrians."

Policy 3.2 reads:

> "New elevated and surface freeways should bypass or terminate outside San Francisco, rather than pass through the city."

And Policy 18.3:

> "The existing single-occupant vehicular capacity of the bridges, highways and freeways entering the city should not be increased and should be reduced if needed to increase the capacity for high-occupancy vehicles, transit and other alternative means of commuting, and for the safe and efficient movement of freight trucks. Changes, retrofits, or replacements to existing bridges and highways should include dedicated priority for high-occupancy vehicles and transit, and all bridges, where feasible, should feature access for bicyclists and pedestrians."]

3. Study Alternatives

To develop managed lane alternatives for evaluation, the study team reviewed the physical and operational characteristics of San Francisco's freeways along with policy and legal constraints, as described in the previous section. As a result of this review, in addition to and in service of the study goals, a few key guidelines emerged for the purposes of this study:

- **Potential for quick implementation:** The study team sought to develop alternatives that would not require extensive construction and could leverage the existing configuration of the freeways. This priority is also in line with San Francisco's other adopted priorities to limit freeway construction and to prioritize investments in transit.
- **Focus on travel to/from Downtown San Francisco & Eastern Neighborhoods:** Significant growth is expected in both downtown San Francisco and the City's Eastern and Southeastern neighborhoods. By improving the reliability and efficiency of freeways that serve these growing areas, more productive travel choices can be made available and more attractive.
- **No expansion of freeway capacity:** San Francisco's general plan calls for no freeway expansion in San Francisco, instead recommending the provision of bus and carpool priority lanes. Expansion of freeways also carries the potential for substantial negative impacts on neighborhoods adjacent to freeways, many of which are Communities of Concern.
- **Increase in person throughput while minimizing impact on traffic:** The study team prioritized opportunities to provide travel time savings and reliability increases for transit and carpools while minimizing the impact on other vehicles. Primarily, this meant identifying freeway segments that are not critically congested today but may become so without intervention in the future, such as I-280 between US 101 and Downtown.

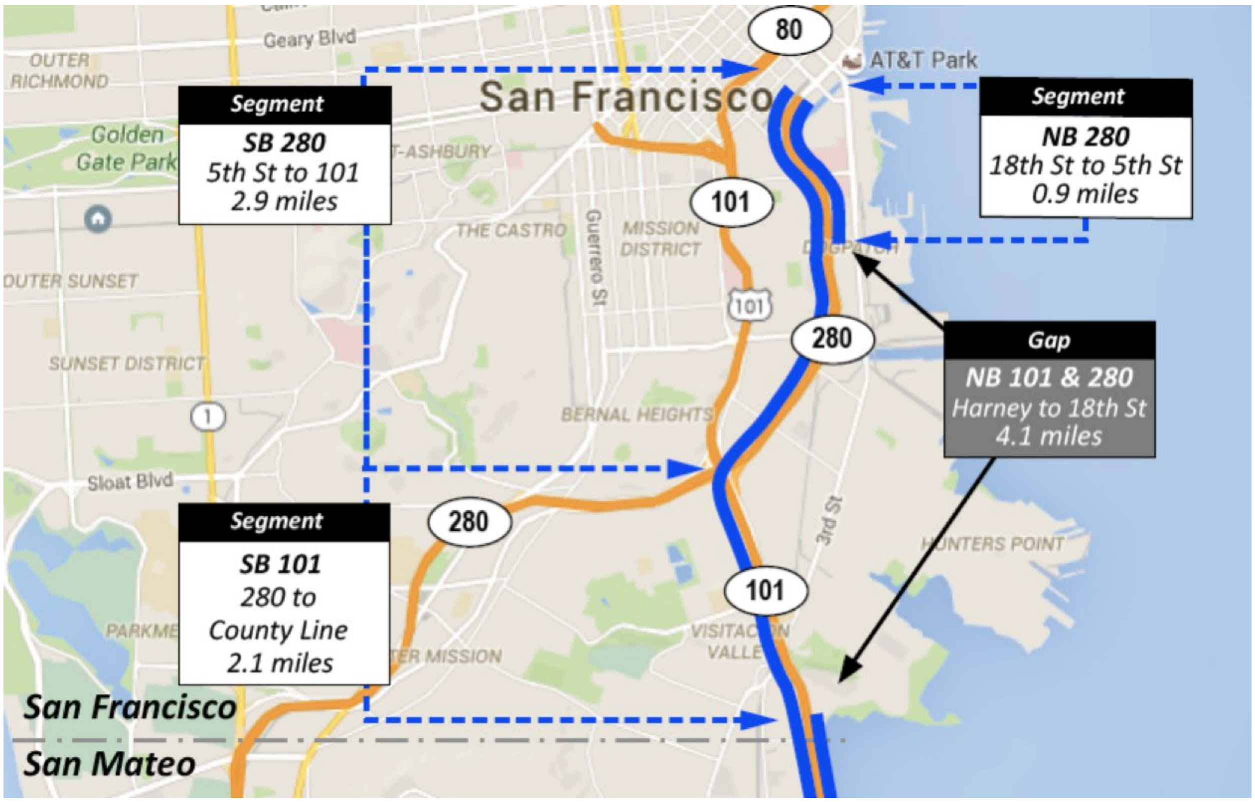
Using the study goals and the guidelines described above, the team focused on a single potential managed lane project configuration with three options for operational strategies. This alternative is detailed below.

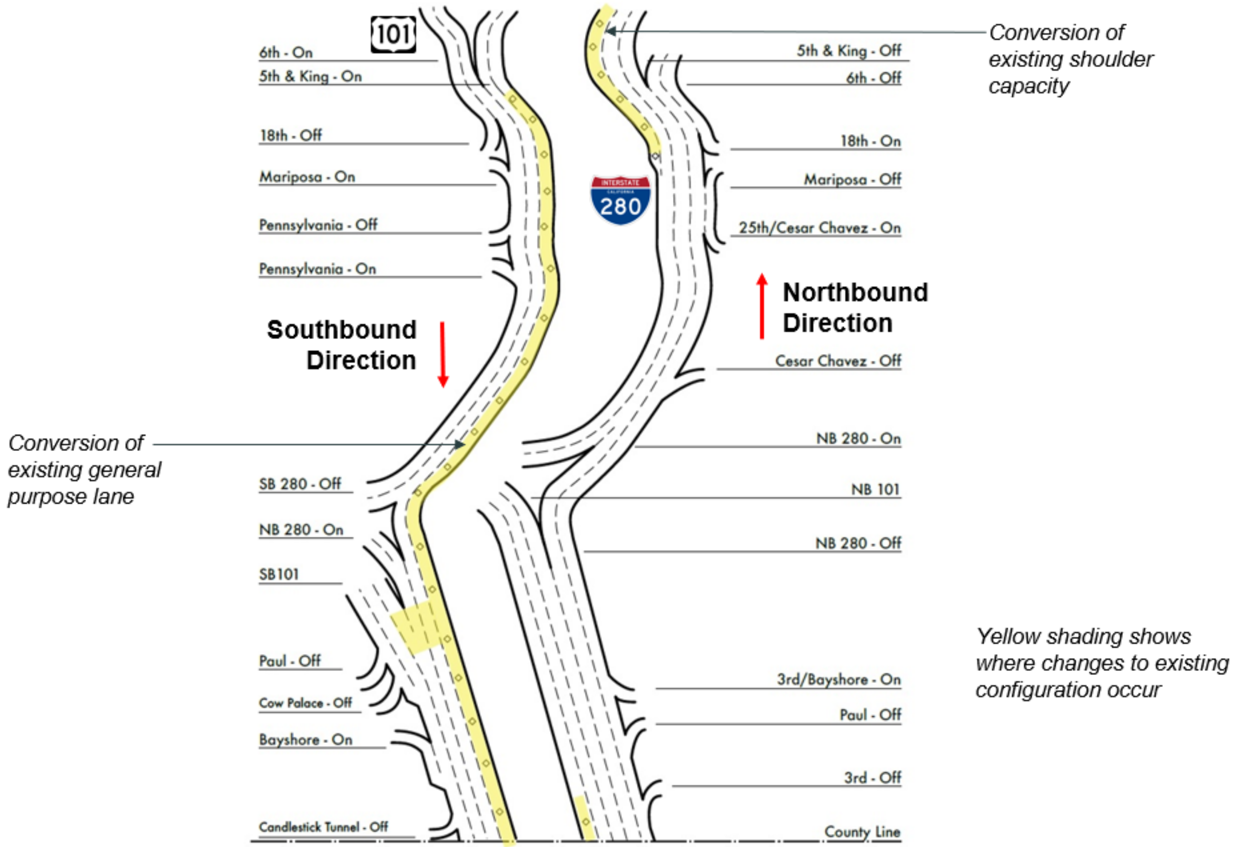
3.1 Physical Configuration:

Southbound, the existing configuration of the I-280 and US 101 freeways allows for the creation of a continuous lane by converting the left-most existing general purpose lane into a managed lane. A carpool or Express Lane could operate along I-280 between the intersection of 5th and

King Streets and US 101, continuing through the interchange to US 101 into San Mateo County, covering a distance of about five miles in San Francisco proper. This extension would be the northern end of a 65-mile managed lane from San Francisco to Morgan Hill, south of San Jose.

Headed northbound, because I-280 exits from the right side of northbound US 101, any carpool or Express lanes entering San Francisco from San Mateo county will likely end at or near the county line. This is necessary to avoid weaving across 101 to reach the right-side exit to northbound 280. However, the study identified an opportunity to provide priority for northbound carpools and buses for approximately one mile along I-280N headed into South of Market, from about 18th Street to 5th Street. This is accomplished by converting the existing wide shoulder into a managed lane, effectively increasing capacity along this portion of northbound I-280.





<u>3.2 Operational Configurations (Occupancy, Transit, and Price):</u>

The physical configuration of the lane described above could be implemented with a variety of operational policies, including both traditional carpool (HOV) and Express Lanes (HOT). When considering a traditional carpool policy, the lanes could have minimum occupancy requirements of either two or three persons, consistent with other carpool lanes in the Bay Area.

The study team also explored whether price management, in the form of Express Lanes, could be used with either of these configurations. Express Lanes could provide the right tool to achieve a balance of traffic that gives buses, carpoolers, and other vehicles in the lane faster travel time and reliability without adding significant delay to the remaining general-purpose lanes. While eligible carpools and buses would access the lane at no cost, the price to enter for non-carpools would be determined by demand, thus ensuring that all available capacity in the lane would be used without becoming congested, and therefore keeping traffic in the lane moving at 45mph, the federal standard for managed lanes.

[Sidebar - What are HOT/Express Lanes, and who can use them?

Traditional high-occupancy vehicle (HOV) lanes require passenger vehicles to have a minimum number of passengers. “HOT” lanes is short for “high-occupancy toll” lanes. HOT lanes are HOV lanes that allow vehicles that don’t meet occupancy requirements to pay a toll to use the lane, while transit and carpools continue to use the lane for free. Variable pricing is used to manage the lane so that reliable performance is maintained at all times, and transit and carpools are prioritized over vehicles that might pay to use the lanes - if the lane is full of buses and carpools, then the system would not even allow other drivers to pay the toll to enter, restricting the lane only to high occupancy vehicles.

Dynamically priced HOT lanes have been implemented around the Bay Area and throughout the United States, and have proven to be more effective than traditional HOV lanes. While communities may call them by different names, such as Express Lanes, the basic operation is the same—HOT lanes encourage carpooling and other transit alternatives while offering vehicles that do not meet standard occupancy requirements another option.

3.2.1 Occupancy

To test the feasibility of both carpool and Express Lane options, the study team developed operational alternatives around three themes, plus one no-build future scenario:

- No Build, where the configuration of freeways remains as it is today. This serves as a point of comparison for the following three build scenarios.
- High Occupancy Vehicle (HOV) with a two-person minimum requirement (HOV2+).
- HOV with a three-person minimum requirement (HOV3+).
- Express Lane with a three-person minimum requirement to access the lane at no cost and a demand based, variable toll for others to access the lane (HOT3+).

3.2.2 Transit

All three build alternatives included projected increases in transit service utilizing the lane, which were developed in coordination with Muni and SamTrans. This is important to boost person-throughput and to help ensure access to the lanes for all uses, particularly low-income travelers. These changes included both routing modifications for existing routes like the 8BX, implementation of planned routes like the Hunter's Point and Candlestick Express services, and incorporation of the preliminary results of SamTrans's 101 Express Bus study. The details of this analysis are described in the following section.

4. Alternatives Analysis

The purpose of the study is to assess the overall performance of the proposed carpool or express lane alternatives to determine whether any of the options should be recommended to move forward in the planning and project development process. As a result, the analysis was a high-level assessment of future peak hour conditions to provide insight on the expected operations to establish overall feasibility of the alternatives. The level of detail and accuracy was commensurate with the data and forecasts available, and should be considered a precursor to more detailed studies (involving refined forecasts and microsimulation traffic analyses) that must be conducted during subsequent project development and environmental review phases.

The physical configuration detailed above was analyzed at a high-level for performance across four potential operational policies in the near term (2020), as noted in the previous section:

- No Build, where the configuration of freeways remains as it is today. This serves as a point of comparison for the following three build scenarios.
- High Occupancy Vehicle (HOV) with a two-person minimum requirement (HOV2+).

- HOV with a three-person minimum requirement (HOV3+).
- Express Lane with a three-person minimum requirement to access the lane at no cost and a demand based, variable toll of $0.25-$1.00 per mile for others to access the lane (HOT3+).[2]

In pursuit of the City's Transit First policies and equity goals, improvements and additions to Muni and SamTrans service were included in all build scenarios. Muni service includes an enhancement to the 8BX service to run all day and take advantage of the lanes within San Francisco, as well as the addition of the Hunters Point Express and Candlestick Express service, currently planned to come online as development in each neighborhood proceeds, serving both new and existing residents. Improved SamTrans service is based on the early findings of the in-progress US 101 Express Bus Feasibility Study, and was modeled to include eight new express routes that serve both San Mateo County resident trips to San Francisco and San Francisco trips to job centers in San Mateo County.

[Sidebar - What about private commuter shuttles?

Private commuter shuttles, taken together, would represent the Bay Area's seventh largest transit agency by passengers served, and play a significant role in travel in the US 101 corridor. There are 800 shuttle buses that transport around 34,000 people per day across the Bay Area. Of these passengers, approximately 1,800 cross the San Francisco-San Mateo county line on US 101 each day in the morning and evening peak hour. While SFMTA collects data about shuttle routes and stops within San Francisco, it is difficult to estimate what changes may occur to these networks in response to changes on the freeways. For the purpose of this analysis, the project staff rerouted private buses to the carpool or express lane where they would achieve time savings over their current routes and considered their presence in person throughput calculations, but otherwise did not evaluate any changes to ridership or frequency of any private shuttles.]

The analysis was performed by determining the demand for travel across all modes and routes in each scenario in the Transportation Authority's travel demand model, SF-CHAMP, and then applying these demands to a high-level, morning and evening peak hour traffic model. This analysis provided information about travel times and delays for both carpool/Express Lane users and non-users, estimates of the change in number of people moved through the corridor, and city/area-wide metrics like overall vehicle miles traveled and air quality impacts. Appendix C contains additional details about the analysis methodology and approach.

5. Analysis Results

5.1 Freeway Operations

Results of the operational analysis indicate technical feasibility of the proposed lane configuration (based on overall person throughput of the facility and level of delay to vehicles in general purpose lanes) under at least one of the three evaluated operational policies. In 2020, in

[2] This toll rate was developed by the study team to represent a price that would allow the lane to be fully utilized without becoming congested, and is only representative. Should this option advance, additional studies, including traffic and equity studies, would be conducted to gain further clarity on potential toll rates and their impacts on freeway users. Coordination with regional partners would also be crucial.

all of the operational scenarios being considered (HOV2+, HOV3+, HOT3+), the analysis indicates that the Managed Lane will be uncongested and offer a time savings advantage compared to the general purpose lanes, and thus provide an incentive to rideshare or use transit. However, there are tradeoffs in how this incentive is achieved:

- In portions of the corridor where the Managed Lane is created by converting an existing lane, the magnitude to which general purpose lane users will experience increased delays will directly correspond to how many vehicles use the Managed Lane - the more vehicles being moved in the managed lane, the fewer vehicles remain to congest the general purpose lanes. The HOV3+ option has the lowest Managed Lane usage, and thus has the greatest increase in general purpose lane delay, up to an additional 13 minutes (in the southbound evening peak hour).
- The HOV2+ option has the highest use of the Managed Lane and thus the least effect on the general purpose lanes. However, the HOV2+ option has the least potential for growth in carpools as the current level of 2 person or more carpools on the corridor would fill the lane on opening day, and is also not compatible with guidance from the Transportation Authority board to avoid privileging Transportation Network Company (TNC) solo customer trips, which would qualify for HOV2 status. Moreover, the HOV2+ Option presents operational challenges at the transition from San Mateo’s US 101 Managed Lane’s proposed operations requiring a 3 person or more occupancy. This could cause adverse operational and enforcement impacts for users and system managers.
- In some locations where a Managed Lane is created by utilizing the freeway shoulder and retaining the existing number of general purpose lanes (i.e. northbound 280 north of Mariposa), travel times in the general purpose lanes will decrease slightly as vehicles leave the general purpose lanes to utilize the managed lane.

Picking the best option amongst the operating policies is a balancing act, including weighing time savings incentives, opportunities to increase ridesharing and transit usage (raising person-throughput), and the impact on the general purpose lanes. Based on this feasibility level analysis, the HOT3+ option strikes the best balance among these factors. Changes in travel time and person throughput for each scenario are detailed in Appendix C and summarized in Tables 1 and 2. Projected congestion and bottleneck locations are shown in figures XX-XX.

Table 1 - Changes in Travel Time by Scenario

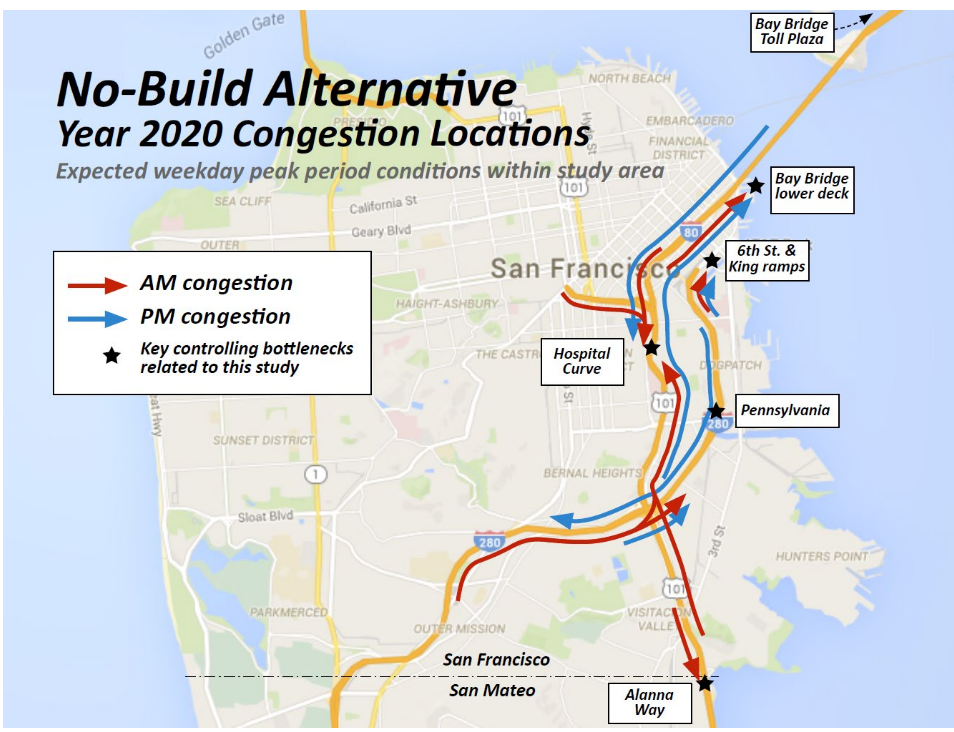
Direction	Operational Scenario in 2020	AM Peak Hour		PM Peak Hour	
		GP Lane	Managed Lane	GP Lane	Managed Lane

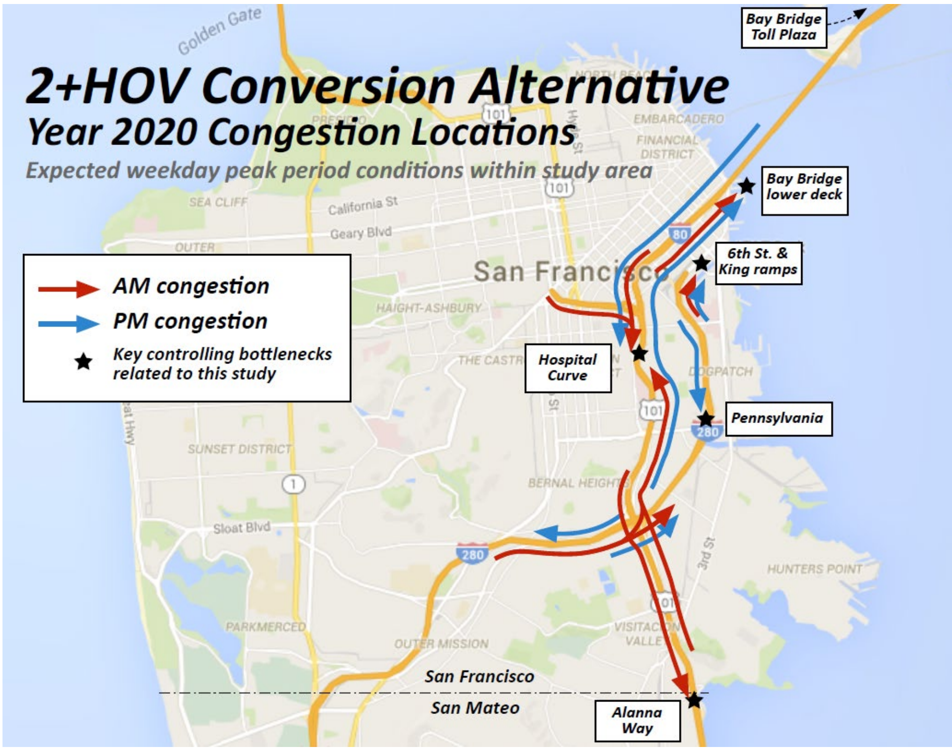
Northbound I-380 to Downtown SF	No Build	24 minutes	-	20 minutes	-
	2-person carpool (HOV2+)	-2	-7	+3	-8
	3-person carpool (HOV3+)	-2	-7	+6	-9
	3-person carpool with option for non-carpools to pay to use the lane (HOT3+)	-3	-7	+2	-8
Southbound Downtown SF to I-380	No Build	17 minutes	-	15 minutes	-
	2-person carpool (HOV2+)	+2	-6	+2	-4
	3-person carpool (HOV3+)	+10	-6	+13	-4
	3-person carpool with option for non-carpools to pay to use the lane (HOT3+)	+4	-6	-3	-4

Table 2 - Changes in Person Throughput by Scenario

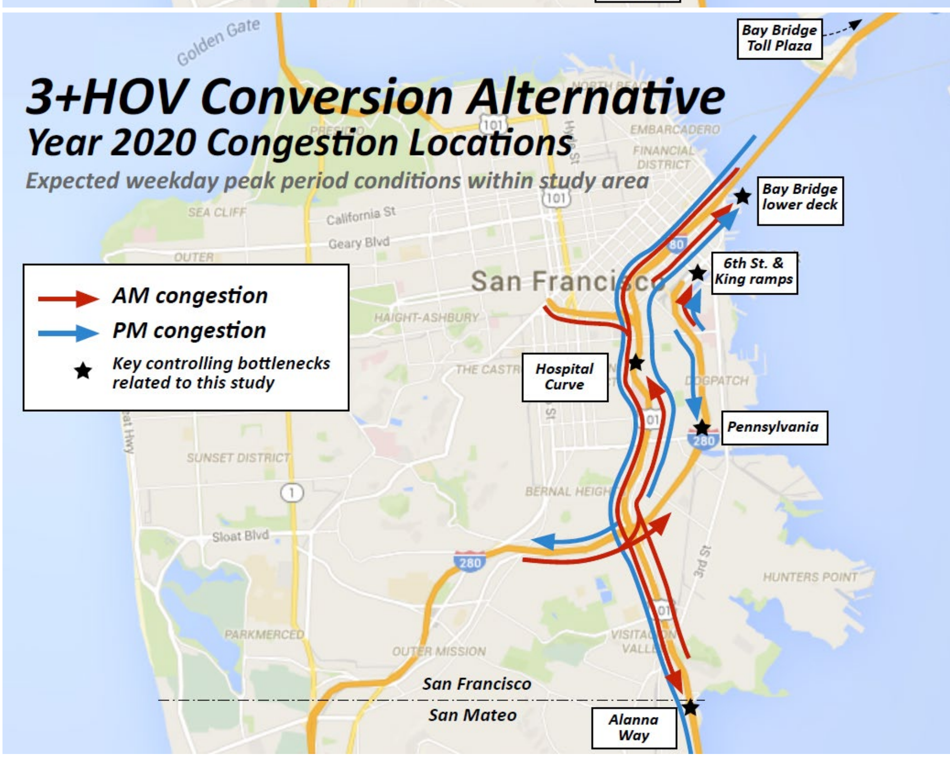
Segment	Screenline Location	Operational Scenario in 2020	AM	PM
US 101 NB	Between Harney Way off-ramp and Harney Way on-ramp (SF County Line)	2-person carpool (HOV2+)	+14%	+13%
		3-person carpool (HOV3+)	-12%	-9%
		3-person carpool with option for non-carpools to pay to use the lane (HOT3+)	+7%	+14%
US 101 SB	Between Bayshore Blvd on-ramp and Alana Way off-ramp (SF County Line)	2-person carpool (HOV2+)	+17%	+19%
		3-person carpool (HOV3+)	-5%	-8%
		3-person carpool with option for non-carpools to pay to use the lane (HOT3+)	+11%	+26%

I-280 NB	Between 18th Street on-ramp and 6th Street off-ramp	2-person carpool (HOV2+)	+40%	+18%
		3-person carpool (HOV3+)	+33%	+10%
		3-person carpool with option for non-carpools to pay to use the lane(HOT3+)	+24%	+8%
I-280 SB	Between 18th Street off-ramp and 18th Street on-ramp	2-person carpool (HOV2+)	+16%	+43%
		3-person carpool (HOV3+)	+7%	+19%
		3-person carpool with option for non-carpools to pay to use the lane (HOT3+)	+2%	+43%

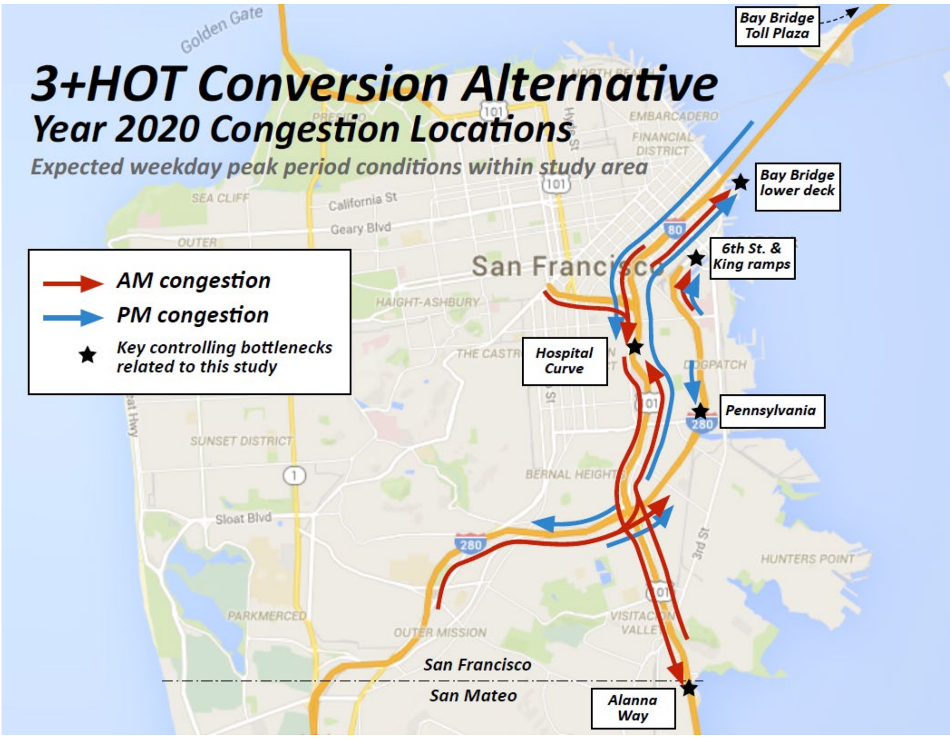




2+HOV Conversion Alternative
Year 2020 Congestion Locations
Expected weekday peak period conditions within study area
AM congestion
PM congestion
Key controlling bottlenecks related to this study
Bay Bridge Toll Plaza
Bay Bridge lower deck
6th St. & King ramps
Hospital Curve
Pennsylvania
Alanna Way
San Francisco
San Mateo



3+HOV Conversion Alternative
Year 2020 Congestion Locations
Expected weekday peak period conditions within study area
AM congestion
PM congestion
Key controlling bottlenecks related to this study
Bay Bridge Toll Plaza
Bay Bridge lower deck
6th St. & King ramps
Hospital Curve
Pennsylvania
Alanna Way
San Francisco
San Mateo



5.2 Local Street Interface

The analysis also conducted a sensitivity analysis on the potential for traffic to divert to local streets when faced with the slightly increased travel times found in this study. The study team initially identified local streets including Bayshore Boulevard, 3rd Street, Alemany Boulevard, Potrero Avenue, and Monterey Avenue as routes where special attention must be paid to potential increases in traffic as a result of the proposed alternatives, and ultimately developed an analysis that would test for increases in volumes on all local streets. The results of this analysis, conducted using SF-CHAMP, showed that under both the HOV2+ and HOT3+ scenarios, no additional traffic was anticipated on any of these or other corridors. Under the HOV3+ scenario, some potential diversions were identified, the largest of which are:

- **Southbound Third Street**: Up to 90 additional vehicles in the peak hour, with greatest increases in the blocks leading toward Cesar Chavez Street and in the Bayview between Evans Avenue and Oakdale Avenue
- **Eastbound Cesar Chavez Street**: About 60 more vehicles in the peak hour approaching I-280
- **Southbound South Van Ness and Southbound Potrero Avenue:** Both streets see about 30 more vehicles per hour in the Mission

As a result of the degradation in travel times and person throughput, along with the potential for local street diversions in the HOV3+ scenario, the study team does not recommend that this operational scenario advance to future phases of project development and evaluation.

5.3 Other Performance Factors

Though the HOV2+ scenario initially appeared to be the most promising in a 2020 timeframe based on the results of the travel time and person throughput analyses, a more detailed investigation into the results provides reason to not advance this operational policy at this time. At numerous segments, the traffic analysis shows that the HOV2+ lane would be at capacity - 1,650 vehicles per hour - in 2020, assuming no “cheaters”, or vehicles with only one passenger, use the lane. Given that the average occupancy violation rate on Bay Area carpool lanes is approximately 20%, the study team has significant concern that an HOV2+ lane would ultimately not be able to provide the travel time savings shown in this analysis. The Transportation Authority board also expressed a preference to ensure that the lanes were not merely being used by TNCs (e.g., Uber and Lyft) that included only a driver and one passenger, which were not reflected in the travel demand modeling work and would also have the potential to add additional vehicles to the lane.

Regional policy conversations and consistency of driver experience factors also point to the need to look more critically at an HOV2+ scenario. The two existing carpool facilities into and out of San Francisco, the Bay Bridge and Golden Gate Bridge, both require 3 person or more carpools today. Additionally, Caltrans and MTC are currently leading an effort to increase the carpool occupancy requirement on I-880, CA 237, and US 101 in Alameda and Santa Clara counties to 3+ under an Express Lane Scenario, and San Mateo County’s preferred alternative for implementation of Express Lanes on US 101 as far north as I-380 is also 3+ occupancy to travel at no cost. Adopting a different occupancy policy along a single corridor or connected facility would create significant driver confusion, traffic operations, and occupancy enforcement difficulties.

Due to these additional factors, the study team does not recommend that the HOV2+ scenario advance to future phases of project development.

5.4 Transportation Performance Conclusions

A summary of the transportation performance feasibility analysis conclusions in the context of the goals of the study is detailed in Appendix A and summarized in Table 3.

Table 3 - Analysis Results Summary

Goal	Key Metrics	HOV2+	HOV3+	HOT3+
Move More People	Person Throughput	○	−	+
Increase Reliability	Travel Time & Variability	○	−	+
Enhance Travel Choices	Availability and Attractiveness of Non-SOV Options	○	○	+
Contribute to a Regional Network	Regional Connections & Policy Alignment	−	○	+
Reduce Emissions	Critical Pollutants & PM	TBD	TBD	TBD
Support Community Well-Being	Diversions & Community Investment	○	−	+

− = Worse than No-Build; ○ = Same as No-Build; + = Better than No-Build

After review of the evaluation of the three operational alternatives, the results indicate that from a transportation performance perspective, a lane conversion alternative operating under either an HOT3+ could advance the goals of this study and warrant more detailed evaluation in subsequent study phases, including a robust review of public policy and equity implications, as detailed in Section 6. HOV3+ creates substantial additional congestion in the corridor, reduces person throughput, and should not advance to further study. HOV2+ is inconsistent with regional and corridor policy and will likely not achieve the outcomes calculated by the travel demand model in real-world conditions, and should also not advance to further study.

6. Outreach and Public Policy Considerations

The study team has met with numerous community, advocacy, and business groups to introduce and hear feedback on the concept of a freeway management strategy in San Francisco, including the potential for Express Lanes. Feedback from outreach conducted to date has been generally neutral to positive, with most participants agreeing with the need for and goals of the study. Many people had specific questions about the proposed physical configuration and some expressed early support or skepticism. Nearly all emphasized the importance of questions of socio-economic equity and transparency: which travelers would benefit from this project, who would pay, and how net fees, generated from any Express Lane alternative, would be spent. It is important to consider carefully project design, subsidy, and revenue investment policies to reduce risks and mitigate potential negative socio-economic impacts of the project, and ensure net benefits to vulnerable communities.

6.1 Socio-economic Equity

At this feasibility phase of the project, the outreach strategy was focused on educating stakeholders about the project and the concepts under evaluation while collecting questions and concerns that are important to community members. While the scope of this study limits the extent that each major theme can be addressed, it is clear that socio-economic equity is an area that requires further study and analysis, as well as deeper public engagement and policy development.

The study team engaged in extensive coordination with peer agencies in response to this feedback, in an effort to better understand best practices to address socio-economic equity concerns related to Express Lanes. As an example, in Los Angeles, Metro's experience highlighted the need to design a package of strategies to complement the lanes, including additional public transit services, and the need to perform an equity analysis to identify potential benefits and impacts for vulnerable communities, including low-income travelers and residents living in neighborhoods adjacent to freeways. Based on Metro's experience in Los Angeles and that of similar studies being conducted in Seattle and Portland, the proposed equity analysis should:

- Utilize various methods including license plate surveys and other means to estimate the demographics of motorists utilizing the study area freeways during peak periods, and assess low-income users willingness and ability to pay to use an Express Lane;
- Conduct extensive direct outreach to Communities of Concern and neighborhood stakeholders regarding Express Lane pricing and revenue reinvestment policies,
- Document environmental and health impacts under existing conditions and potential managed lane scenarios; and
- Identify design features and strategies for mitigating socio-economic impacts and creating benefits for low-income and freeway adjacent communities.

As an example, in Los Angeles, Metro's approach to understanding and addressing community concerns and needs related to socio-economic equity included roughly 800 community meetings with communities along their Express Lane corridors. After considering the input received in these conversations, Metro developed a three-prong strategy to ensure equitable access to the benefits provided by Express Lanes:

- After hearing that the primary need from the community was for more and improved bus service, Metro made significant investments in buses that used the Express Lane and traveled through the neighborhoods adjacent to the Express Lane.
- In addition to this improved bus service, Metro developed two programs to assist low-income drivers who did not have the option of using transit. The first program, available to any person or household that met low-income eligibility criteria as defined for California assistance programs, provided a FasTrak transponder that included $25 of pre-loaded credit and whose account included with a waived monthly maintenance fee.
- Another program, available to all enrolled transit riders with no income thresholds, provided travelers with toll credit for frequent use of transit within the Express Lane corridors. Under this program, regular transit usage provides travelers with the option to

use the lane at no cost, even as a solo driver, should they occasionally need to travel alone by car.

Metro considered all three of these strategies an important part of the overall Express Lanes program. While the expanded bus service was initially funded by a federal grant, the ongoing operation of all three components is now funded by net revenues generated from the Express Lanes themselves (See Section 6.2)

The study team recommends advancing more detailed analyses and conversations around equity in pricing, detailed multimodal traffic studies, and additional improvements to transit as priorities should the study move into subsequent phases of environmental review and design.

6.2 Net Revenue and Revenue Re-investment

While it is too early to assess the potential for any San Francisco Express Lanes (HOT3+) to generate net revenue (after covering operating, maintenance and financing costs), there is reason to believe that a managed lane corridor in San Francisco on US 101/I-280could generate positive revenues in the future. Currently operational lanes in Alameda and Santa Clara Counties generate positive net revenue (after an initial operational period of not doing so), and San Mateo County's studies is similarly expected to generate positive net revenue, which could then be re-invested into the corridor. For Express Lanes in San Francisco, future project studies would examine the financial risks and projections of costs and revenue more fully, as well as policies governing the use of net revenue for improvements benefitting the corridor in which they were generated, consistent with state law.

7. Recommendations & Next Steps

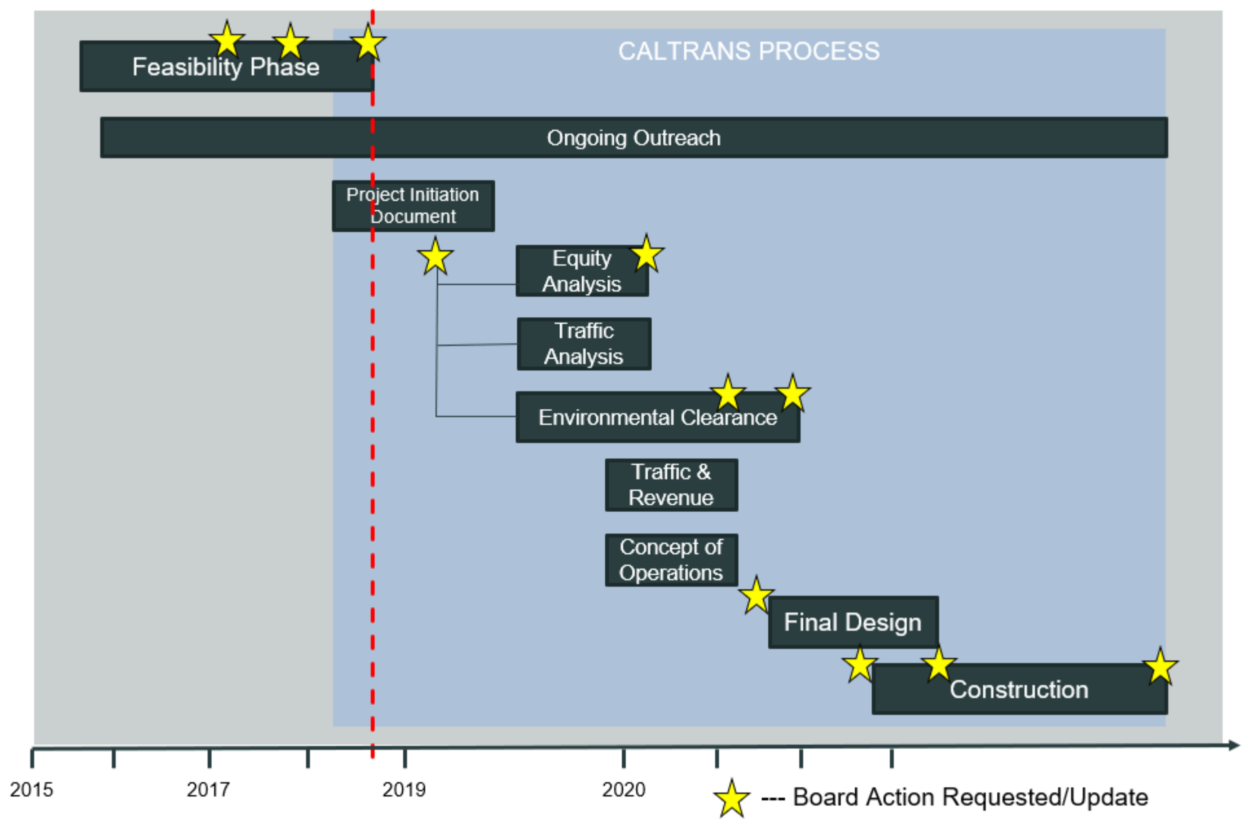
The study team recommends that the Transportation Authority advance project development and evaluation for a lane conversion, Express Lane (HOT3+ operational policy) management strategy for the US 101 and I-280 freeways in San Francisco.

Additional project development steps include a detailed review of full-day multimodal traffic operations and performance on both the freeway and local streets (particularly in the vicinity of the touchdown location in San Francisco), the inclusion of complementary system and demand management strategies (e.g. park and ride lots and 3rd party carpool services), and further consideration of strategies to maximize transit utilization of the Express Lane in conjunction with Muni, SamTrans, and others. Possible smart freeway/technology strategies that could be considered in order to maximize the performance of both the safety and operational performance of the managed lane itself as well as the entire corridor include:

- Adaptive Ramp Metering and Transit Priority Measures
- Interchange/Connector Metering
- Vehicle occupancy detection systems
- Enhanced Incident Detection (Cameras, Video, Detectors, etc.)
- Enhanced Incident Response (Freeway Service Patrol, Call Boxes, etc.)
- Enhanced CHP Enforcement
- Park & Ride Facilities
- Traveler Information and Signage
- Signal Coordination

- Transit Service Enhancements
- Carpool services
- Bike/Ped Connectivity (especially to Transit or Shared Rides)
- Local or regional policies around private shuttles use of managed lanes
- Local policy around rideshare use of managed lanes

From a project design and environmental review standpoint, the next phase of advancing the concept identified here would be for the Transportation Authority enter into a Cooperative Agreement with Caltrans to develop a Project Initiation Document (PID), required for any changes or improvements on the state highway system. A Project Study Report-Project Development Support (PSR-PDS) is the recommended project initiation document that will provide a key opportunity for Caltrans and regional and local agencies to achieve consensus on the purpose & need, scope, and schedule of the project and its environmental review. The purpose for using the PSR-PDS document is to gain approval for project studies to move into the Project Approval and Environmental Document (PA&ED) phase. Figure X summarizes the future project phases and SFCTA Board actions/updates along the way.



In addition to the PID document, successful implementation of a managed lane, particularly one created by the conversion of existing capacity, will involve significant interagency coordination on a variety of policies and legislative actions. For example:

- The status of the legal framework around conversion of a lane to an Express Lane will need to be confirmed and will potentially require changes to state legislation and/or the development of interagency agreements with FHWA[3][4]
- Passage of AB2865 (Chiu) in 2018 provides San Francisco with the option of utilizing Santa Clara Valley Transportation Agency (VTA) in addition to BATA as a tolling partner, and both options would need to be further explored to support this decision.
- Strategies to maximize the occupancy of vehicles in the corridor and encourage usage of the lane by transit and carpools to the fullest extent will need to be considered and developed. San Francisco, San Mateo, and Santa Clara Counties, with Caltrans, MTC, and CalSTA are currently beginning this process through the 101 Mobility Action Plan, which will develop recommendations for policies and programs to encourage carpooling and transit in the corridor in a future where a continuous managed lane is available.
- Evaluation of the impacts of any priced scenario on low-income commuters, and the development of programs to address these impacts, is critical to the project's success. The SFCTA is in process of developing a detailed investigation into the profile of drivers to, from, and within San Francisco to gain a better understanding about who might be impacted by projects such as Express Lanes.

Further study is recommended for these and other policy considerations in parallel with the Caltrans project development and environmental review process. Information developed and reviewed during this study will create an important foundation for subsequent studies and detailed understanding of the operations and impact of any managed lane in the corridor.

Appendix A: Goals, Metrics, and Evaluation Results

Appendix B: Existing Conditions Report

Appendix C: Traffic Analysis Methodology and Results

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[3] *Tolls and Federal Highway Funding Consequences:* https://www.cga.ct.gov/2018/rpt/pdf/2018-R-0244.pdf

[4] *Current Laws on Tolling Existing and New Facilities on Federal Interstate Highways:* https://www.dotdata.ct.gov/ct_congestion_site/reports.html

Appendix A: Goals & Metrics

Introduction

The results of the feasibility analysis of the potential operations policies for a managed lane in San Francisco, primarily converted from existing general purpose capacity, are presented in the Freeway Corridor Management Study (FCMS) Phase 2 Final Report. The analysis was based on a set of goals identified in the FCMS Phase 1 Report, adopted in 2015. This appendix offers a more in-depth explanation of the scoring for each goal and metric, summarized in Table 1 below.

Table 1: Summary of Goals and Metrics

Goal	Key Metrics in FCMS Phase 2
Move people efficiently: We need to get more travelers to their destinations as quickly and reliably as possible in the existing freeway footprint.	• **Person Throughput:** The number of person-trips carried in the corridor, measured at the San Francisco/San Mateo County Line on US 101 and at Mariposa Street in San Francisco on I-280.
Increase trip reliability: More reliable travel times will help everyone, from parents picking up their children from school to commuters who need to get to work on time.	• **Travel Time:** Travel time for both managed lanes users and non-users from the US 101/I-380 interchange in San Mateo County to 5th & King in Downtown San Francisco. • **Travel Time Variability*:** Congested freeways are more impacted and able to recover less quickly from unusual incidents such as large events or traffic collisions. This metric provides a qualitative assessment of potential travel time variability.
Enhance travel choices: Better transit and incentives to carpool give commuters convenient new travel options.	• **Availability & Attractiveness of Non-Single Occupant Vehicle Options for Travel*:** Does the scenario have potential to provide better incentives (through travel time savings) and better availability (through better service) to use transit or carpool?
Contribute to a regional network: San Francisco's freeway management strategies will be coordinated with similar projects in San Mateo and across the region.	• **Regional Connections & Policy Alignment*:** Do operating policies align with other regional projects for traveler consistency and ease of use?
Reduce emissions: Moving more people in fewer vehicles will help achieve our climate goals as our population grows.	• **N/A**: More detailed traffic studies are required to accurately report on this goal; the FCMS Phase 2 defers to that future analysis. Potential metrics include regional Greenhouse Gas emissions and local Particulate Matter (PM) and other pollutants.
Support community well-being: We must ensure that any changes to freeway operations support equity and safety in nearby neighborhoods.	• **Diversions:** Will the scenario result in diversion of traffic to local streets? • **Community Investment*:** Does the scenario have the potential to generate investments to ensure equitable benefits, better transit, and other potential improvements?

*Items with an asterisk represent a qualitative metric in this feasibility study; future phases may be able to asses these metrics quantitatively.

For the purposes of this feasibility level analysis, the three operational alternatives were compared to a no-build scenario (or scenario where no intervention is made on San Francisco's freeways but other planned projects continue) in the year 2020. The three operational alternatives are:

- **HOV2+:** 2 Person Carpool. The lane may be used by transit and vehicles with two or more passengers at no cost. No other vehicles may legally access the lane.
- **HOV3+:** 3 Person Carpool. The lane may be used by transit and vehicles with three or more passengers at no cost. No other vehicles may legally access the lane.
- **HOT3+:** Express Lane. The lane may be used by transit and vehicles with three or more passengers at no cost. Other vehicles may pay to use the lane at a variable rate, determined by demand, if additional capacity remains.

The summary results of the analysis are presented below in Table 2. Details of this analysis, including travel time and person throughput figures by direction and time of day, are included in Appendix C. An explanation of these results by scenario is provided in the following sections.

Table 2: Analysis Results Summary

Goal	Key Metrics	HOV2+	HOV3+	HOT3+
Move More People	Person Throughput	O	–	+
Increase Reliability	Travel Time & Variability	O	–	+
Enhance Travel Choices	Availability and Attractiveness of Non-SOV Options	O	O	+
Contribute to a Regional Network	Regional Connections & Policy Alignment	–	O	+
Reduce Emissions	Critical Pollutants & PM	TBD	TBD	TBD
Support Community Well-Being	Diversions & Community Investment	O	–	+

– = Worse than No-Build; O = Same as No-Build; + = Better than No-Build

Scenario Assessment & Results

HOV2+ Scenario

HOV2+ Scenario Evaluation Summary

The results of the HOV2+ Scenario Evaluation are summarized in Table 3 below.

Table 3: HOV2+ Evaluation Results

Goal	Key Metrics	HOV2+ Performance	Comments
Move More People	Person Throughput	O	While modeling results showed initial promise for person throughput (between 600 and 1,900 more people per hour, depending on direction and time of day), at-capacity operations increase the likelihood that an HOV2+ lane would become congested and result in no substantially different performance from the No-Build.
Increase Reliability	Travel Time & Variability	O	At-capacity operations at bottlenecks in both the carpool lane and remaining general purpose lanes increase the likelihood that an HOV2+ lane would become congested and result in no substantially different performance from the No-Build.
Enhance Travel Choices	Availability and Attractiveness of Non-SOV Options	O	At-capacity operations at bottlenecks in both the carpool lane and general purpose lanes provide no travel time incentive to use transit or carpool.
Contribute to a Regional Network	Regional Connections & Policy Alignment	−	A two or more occupancy policy does not align with San Mateo County's preferred alternative or regional efforts to created consistent occupancy requirements.
Reduce Emissions	Critical Pollutants & PM	TBD	More detailed analysis is required.
Support Community Well Being	Diversions & Community Investment	O	With operations anticipated to be substantially similar to the No-Build, no diversions are expected to occur. No potential for additional investments in transit or adjacent communities is anticipated in either this or the No-Build scenario.

− = Worse than No-Build; O = Same as No-Build; + = Better than No-Build

HOV2+ Scenario Evaluation Details

The HOV2+ scenario is expected to perform substantially similar to the No-Build alternative on or shortly after opening based on the results of the travel demand and traffic analysis. While initially promising, the results of the travel demand and traffic models show that the carpool lane would actually be at capacity from its initial opening, leaving no room for growth in the corridor, potential impacts from the effects of carpool cheaters and clean-air vehicles, or incident management. As a result, the scenario is not expected to offer an incentive to use transit or carpool in the corridor. Additionally, a two or more occupancy policy does not align with San Mateo County's preferred alternative of three or more on the segment of US 101 immediately to the south of this project, nor with regional efforts led by MTC to create a consistent three or more carpool lane occupancy requirement on I-80, I-880, CA 237, US 101, and Bay Area bridges. Finally, while no additional diversions of traffic to surface streets are expected as a result of this scenario, this operational policy does not have the potential to directly support investment in transit or other community transportation improvements as there is no revenue generating component.

HOV2+ Scenario Conclusions and Recommendations

Because the HOV2+ Scenario does not score better than the No-Build scenario on any key metric and does not support regional efforts around high-occupancy vehicle facilities, it is not recommended to advance to future project phases.

HOV3+ Scenario

HOV3+ Scenario Evaluation Summary

The results of the HOV3+ Scenario Evaluation are summarized in Table 4 below.

Table 4: HOV3+ Evaluation Results

Goal	Key Metrics	HOV3+ Performance	Comments
Move More People	Person Throughput	**–**	Model results show a significant decrease in person throughput, with about 1,000 fewer people moved per hour at the County Line.
Increase Reliability	Travel Time & Variability	**–**	While the carpool lane would be free-flowing in an HOV3+ scenario, saving users between 4 to 9 minutes over the No-Build, the general purpose lanes would be overburdened and see significant increases in delay, with 6 to 13 minutes of additional travel time.
Enhance Travel Choices	Availability and Attractiveness of Non-SOV Options	O	While the free-flowing carpool lane provides an incentive to use transit or carpool, it does so at the expense of significant delay to the general purpose lanes, and travel demand modeling does not show significant new carpool formation.
Contribute to a Regional Network	Regional Connections & Policy Alignment	O	A three or more occupancy policy aligns with San Mateo County's preferred alternative and regional efforts to created consistent occupancy requirements.
Reduce Emissions	Critical Pollutants & PM	TBD	More detailed analysis is required.
Support Community Well Being	Diversions & Community Investment	**–**	With significant new delay created on the freeways, diversions to local streets are expected to occur. No potential for additional investments in transit or adjacent communities is anticipated in either this or the No-Build scenario.

– = Worse than No-Build; O = Same as No-Build; **+** = Better than No-Build

HOV3+ Scenario Evaluation Details

In the HOV3+ Scenario, travel demand and traffic analysis results indicate that the carpool lane will be free flowing and well under capacity, saving travelers in those lanes between 4 and 9 minutes between the U.S. 101/I-380 interchange and downtown San Francisco compared to the No-Build scenario. The carpool lane provides an incentive to use transit and carpool, however with fewer 3+ person carpools forming under this scenario than there is lane capacity in the carpool lane, the remaining general purpose lanes become even more congested than the No-Build scenario, moving fewer vehicles and people overall. In the general purpose lanes, delays increase by about 6 to 13 minutes in both the morning and evening in all directions except northbound in the a.m. peak hour, where travel times decrease by about two minutes.

A three or more occupancy policy aligns with San Mateo County's preferred alternative on the segment of US 101 immediately to the south of this project and with regional efforts led by MTC to create a consistent three or more carpool lane occupancy requirement on I-80, I-880, CA 237, US 101, and Bay Area bridges. Unlike all other scenarios, this operational policy is anticipated to result in diversions of traffic to surface streets (up to an additional 200 vehicles per hour on 3rd St), but does not have the potential to directly support investment in transit or other community transportation improvements (including mitigations of these diversions) as there is no revenue generating component.

HOV3+ Scenario Conclusions and Recommendations

Because the HOV3+ Scenario scores worse than the No-Build scenario on many key metrics and no better than the No-Build scenario on all others, it is not recommended to advance to future project phases.

HOT3+ Scenario

HOT3+ Scenario Evaluation Summary

The results of the HOT3+ Scenario Evaluation are summarized in Table 5 below.

Table 5: HOT3+ Evaluation Results

Goal	Key Metrics	HOT3+ Performance	Comments
Move More People	Person Throughput	+	Person throughput is expected to increase by 600 to 2,200 people per hour, depending on direction and time of day, based on this analysis.
Increase Reliability	Travel Time & Variability	+	A free-flowing Express Lane, which includes active management of capacity, ensures travel time savings (between 4 and 9 minutes over the No-Build) reliability for carpools, transit, and other users.
Enhance Travel Choices	Availability and Attractiveness of Non-SOV Options	+	A free-flowing Express Lane creates an incentive to use transit or carpool, as reflected in the Person Throughput metric.
Contribute to a Regional Network	Regional Connections & Policy Alignment	+	A three or more occupancy, express lane policy is San Mateo County's preferred alternative and is consistent with regional occupancy policy.
Reduce Emissions	Critical Pollutants & PM	TBD	More detailed analysis is required.
Support Community Well Being	Diversions & Community Investment	+	No diversions are expected to occur. This scenario also has the potential for additional investments in transit and adjacent communities funded by revenue from single-occupant vehicles.

− = Worse than No-Build; **O** = Same as No-Build; **+** = Better than No-Build

HOT3+ Scenario Evaluation Details

In the HOT3+ Scenario, analysis results indicate that the Express Lane will be free-flowing, saving travelers in those lanes between 4 and 9 minutes between the U.S. 101/I-380 interchange and downtown San Francisco compared to the No-Build scenario, and can be actively managed through adjustments to pricing to maintain vehicle throughput just below capacity resulting in travel time reliability and an incentive to use transit or carpool. In the general purpose lanes, delays increase by about 2 minutes in the northbound direction in the evening and 4 minutes in the southbound direction in the morning, while saving general purpose lane users about 3 minutes in both the northbound direction in the morning and the southbound direction in the evening.

An HOT3+ operational policy aligns directly with San Mateo County's preferred alternative of three or more on the segment of US 101 immediately to the south of this project and with regional efforts led by MTC to create a consistent three or more occupancy Express Lane system on I-80, I-880, CA 237, US 101, and Bay Area bridges. Finally, while no additional diversions of traffic to surface streets are expected as a result of this scenario, this operational policy has the potential to directly support investment in transit or other community transportation improvements through investment of potential net revenues from the pricing component.

HOT3+ Scenario Conclusions and Recommendations

Because the HOT3+ Scenario scores better than the No-Build scenario on all metrics, it is the staff recommendation for further study to advance to future project phases.

San Francisco County Transportation Authority
Freeway Corridor Management Study — Phase 2

Appendix B: Existing Conditions Report

In support of the
SM/SF-101 and SF-280 Managed Lanes Feasibility Study

AECOM

etc. Emergent Transportation Concepts

W-Trans

Freeway Corridor Management Study — Phase 2

Appendix B: Existing Conditions Report

TABLE of CONTENTS

INTRODUCTION

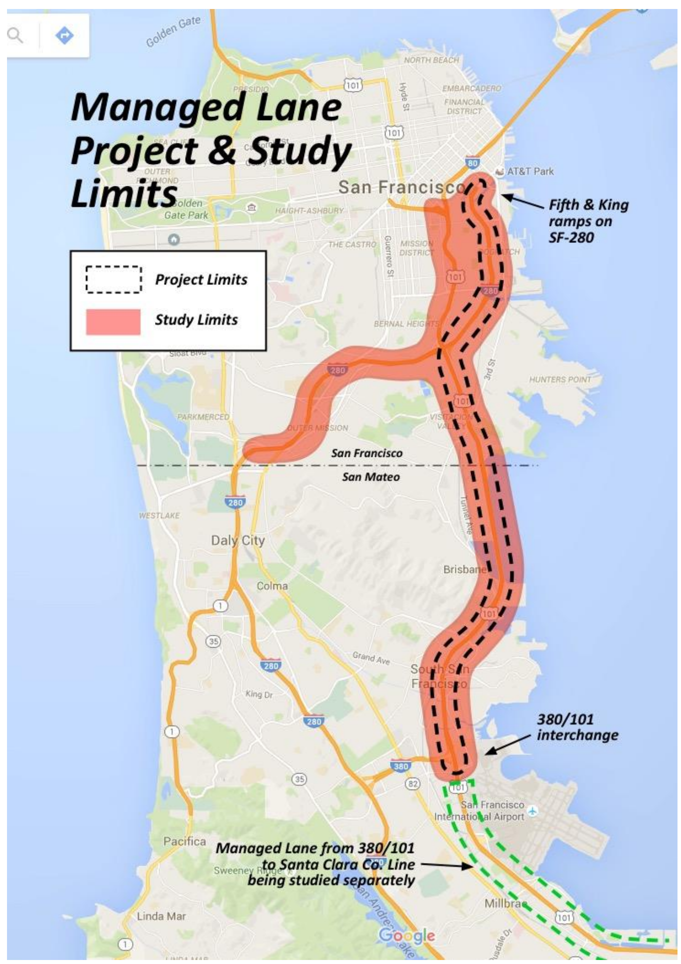
The original purpose of the San Francisco County Transportation Authority's (SFCTA) Freeway Corridor Management Study (FCMS) Phase 2 (Project) was to evaluate the feasibility of potential technology-related and demand-related strategies to manage San Francisco's freeway corridors. After the study got underway, interest arose from both the Governor's Office and local partner agencies in connecting a Managed Lane project in San Francisco to a similar project on US 101 in San Mateo County. There is a strong desire to implement such a facility as soon as possible to alleviate severe congestion on US 101 occurring as a result of continued expansion of the high tech sector along the Peninsula and South Bay. As a result, the focus of the FCMS Phase 2 study shifted to studying options to provide a continuous Managed Lane facility through San Mateo County and into San Francisco. Specifically, the FCMS study is now investigating the potential for a continuous facility that connects to the planned Managed Lanes on US 101 south of I-380. Beginning at the 101/380 interchange in San Bruno, the subject facility would continue on US 101 northward to the 101/280 interchange in San Francisco, where it would switch to the eastern portion of I-280 to reach the touchdown ramps at 5th and King Streets. As an adjunct to the freeway Managed Lanes, this study also is investigating the feasibility of a bus-only facility on city streets connecting the ramp termini on I-280 to the downtown area.

BACKGROUND

This report describes existing conditions on the freeways within the larger study area (Figure 1), as well those associated with the proposed Managed Lane on US-101 from the 380/101 interchange in San Mateo County to the terminus of Interstate 280 in downtown San Francisco (Project Area), with respect to traffic operations as well as physical configurations. Information on local streets and transit that will be affected by a Managed Lane within the study limits is also presented.

This Existing Conditions report is intended to provide summaries and compilations of traffic performance and physical facility characteristics. To the maximum extent possible, available data sources were employed for this purpose, and minimal new data collection was performed. Data sources are described in detail in Appendix B: Data Methodology. For the purposes of this report, the AM Peak Period is defined as 6-10AM, and the PM Peak Period is defined as 3-7PM.

Figure 1



This information establishes the foundation for the screening of Managed Lane options and the detailed traffic analysis of proposed alternatives. The metrics by which traffic conditions under proposed alternatives are compared will be based on the broad set of goals and objectives articulated in Phase 1 of the FCMS. Corresponding metrics for assessing the goals under existing/future conditions are listed in Appendix A, and will be covered in detail in the Final Report.

FACILITY DESCRIPTION

Description of Freeway Facilities

The two freeways included in this study are US 101, from the I-380 interchange in San Mateo County to the I-80 Junction in San Francisco, and I-280, from the San Francisco/San Mateo County Line to the end of the freeway in San Francisco; at 5th and King Streets. US 101 is one of the key north-south freeways in the Bay Area, serving local and interregional traffic by connecting Downtown San Francisco and the San Francisco International Airport to the Peninsula and South Bay. I-280 also runs north-south, and in San Francisco connects Daly City to the downtown area. Historically, commute patterns on these freeways were primarily travel into downtown San Francisco in the morning and leaving San Francisco in the evening. However, the typical weekday commute has evolved significantly in the last decade due to the creation of major employment centers in the Peninsula and South Bay, as well as new land use and demographic patterns within San Francisco. Lane configurations and cross section dimensions for the US 101 and I-280 corridors are shown in Appendix G. The dimensions are derived from aerial photo imagery and are preliminary in nature.

US 101

The study area on US 101 begins at the I-380 interchange in San Bruno and ends at the 80/101 interchange, a distance of about 10 miles. In San Mateo County, US 101 is primarily an 8-lane facility through flat terrain, with auxiliary lanes in some locations. In San Francisco, US 101 varies from 6 lanes to 10 lanes, with the fewest number of lanes on the section that traverses under the 280/101 interchange. Inside and outside shoulder widths vary, though there are several locations in the San Francisco section of US 101 with less than standard shoulder widths.

Interstate 280

I-280 is a major south-north freeway that mainly serves regional travel and is a highway alternative to US 101 for trips between downtown San Francisco and the South Bay. Within the study area, the corridor begins at the San Francisco/San Mateo County Line and ends at 5th Street in San Francisco, a distance of about 7 miles. The section of I-280 north of the 280/101 interchange is primarily a standard 6-lane facility with auxiliary lanes, with full width shoulders except at the ramp termini at 6th and 5th Streets.

ITS Infrastructure

Both US 101 and I-280 within the project area have a relatively basic set of Intelligent Transportation System (ITS) features currently in place, with the available ITS elements usable mainly for motorist information and incident detection purposes. There are 15 changeable message signs (CMS) installed within or immediately outside of the study limits; 5 on US 101, 7 on I-280, and 3 on I-80 east of the 80/101 interchange in San Francisco. There are 25 closed-circuit television (CCTV) surveillance cameras within or immediately outside of the study limits; 10 on US 101, 11 on I-280, and 4 on I-80. Roadway detection, in the form of inductive loops or magnetometers, are located on the freeway mainline throughout the study area, and their data is available through the Caltrans Performance Measurement (PeMS) system. However, a review of the data indicates that many of these detection stations are either unreliable or non-functional. None of the ramps within the study area currently transmit data to PeMS, even if detectors are installed on those ramps. Ramp metering is in operation on US-101 in San Mateo County, but not within San Francisco. A full listing of ITS features currently installed within the study area is provided in Appendix H.

FREEWAY OPERATIONS

US-101 is one of the most congested freeways in the region, with the segment in San Francisco from the 280/101 interchange to I-80 and the Bay Bridge ranked as the fourth most congested freeway section in MTC's 2015 Vital Signs report. As with any freeway experiencing congestion, traffic operation is constrained at bottlenecks where vehicular demand exceeds the capacity of the facility. Thus, developing a clear understanding of the locations of existing controlling bottlenecks is essential to determining the effect and feasibility of a managed lane option. Some of the bottlenecks are outside of the proposed project limits, but nevertheless need to be considered as they affect traffic conditions within the project limits.

A detailed description of the data that was used for this study is provided in Appendix B. Speed and travel time data to assess congestion was obtained from INRIX and Caltrans PeMS. Weekday data (Tues-Thurs) from March and April 2015 was extracted for this preliminary study to best represent average non-Summer and non-holiday conditions. Floating car runs were conducted during peak periods in April 2016 to further verify the locations of bottlenecks and limits of congestion. Finally, floating car runs from the June 2016 San Mateo County US 101 Ramp Metering Project "After" Study was used as reference for the section of 101 from 380 to the county line. Existing congested freeway sections are shown in Figure 2, with key controlling bottlenecks numbered. Peak travel times for the San Francisco segments are shown in Figure 3. While the conditions described here may constitute "typical" conditions, it is acknowledged that on days in which major incidents or special events occur, congestion levels and delays may be considerably worse.

FREEWAY CONGESTION PATTERNS

NORTHBOUND OPERATION

AM Conditions

<u>101</u>: During typical morning peak periods, , traffic conditions are generally free of congestion from 380/101 up to the SF/SM county line. A major bottleneck occurs regularly outside of the project limits, but inside of the study area, at the four-lane section downstream of the Cesar Chavez on-ramp (generally referred to as "Hospital Curve") ***(1)***. Queues from this bottleneck extend into the project area and as far back as the Third Street interchange on 101, with congestion occurring from 7:00 to 9:30 AM. Maximum individual delays are 9.7 minutes from the SF/SM County Line to Hospital Curve. Downstream of Hospital Curve, morning conditions are generally free of congestion except at the approach to the lower deck of the Bay Bridge.

<u>280</u>: On I-280 in San Francisco, congestion occurs approaching the 280/101 interchange due to demand exceeding the capacity of the two-lane connector to northbound US-101. Capacity of this connector is constrained by queuing extending back from the Hospital Curve bottleneck on US 101. Congestion in the left lanes of NB I-280 leading to that connector propagate upstream and across all northbound lanes extending as far upstream as the Ocean Avenue interchange. This congestion limits the number of vehicles from I-280 south of the 280/101 interchange that can reach the northerly segment of I-280 and the southbound lanes of US 101. On northbound I-280 north of the 280/101 interchange, short sections of congestion occur in the three-lane sections near the 25th Street and Mariposa interchanges. The primary northbound constraint on this section of I-280 are the capacity of the off-ramp and local street interfaces ***(2)*** at 6th Street & Brannan and at 5th Street & King. Queues from these intersections extend as far back as the Mariposa interchange on I-280, resulting in maximum individual delays of 7.4 minutes.

PM Conditions

<u>101</u>: During the evening peak period, which is from 3-7PM, queues from the bottleneck at the entrance to the lower deck of the Bay Bridge ***(3)*** generally extend into the project study area, but usually only as far upstream as the 280/101 interchange. Because of the magnitude of the queuing from the Bay Bridge, the Hospital Curve bottleneck does not appear independently during the evening peak period, although it is likely that that freeway section is at or near capacity. On northbound US-101 in San Mateo County, congestion develops with some regularity approaching the Sierra Point Parkway interchange ***(5)***. Although this congestion does not occur every day, it is an indication that the freeway segments in this vicinity are at, or are nearing, capacity.

<u>280</u>: On I-280, the only recurrent evening congestion and delays occur approaching the 6th Street and King Street off-ramps ***(2)***, with queuing at its worst extending back to the 6th Street off-ramp gore point. Maximum individual delays approaching the King Street off-ramp are about 2.0 minutes.

SOUTHBOUND OPERATION

AM Conditions

<u>101</u>: During typical morning peak periods, congestion occurs on southbound US-101 between Bayshore Boulevard and the 280/101 interchange due to a bottleneck at the lane drop downstream of the Bayshore Boulevard off-ramp ***(4)***. This congestion typically lasts from 6:00 to 9:00 AM. Conditions are generally free of congestion south of this point to the 380/101 interchange.

<u>280</u>: On I-280, traffic volumes entering the freeway are constrained by the capacity of the intersections at 6th Street & Brannan and at 5th Street & King ***(2)***. Although the 6th Street and King Street on-ramps are both two lanes, there is not enough output from the foot-of-ramp intersections to exceed the capacity of the three-lane sections of I-280. As a result, conditions are generally free flow from King Street to the 280/101 interchange during the morning peak period, as southbound on-ramp volumes between the Downtown area and the 280/101 are relatively low.

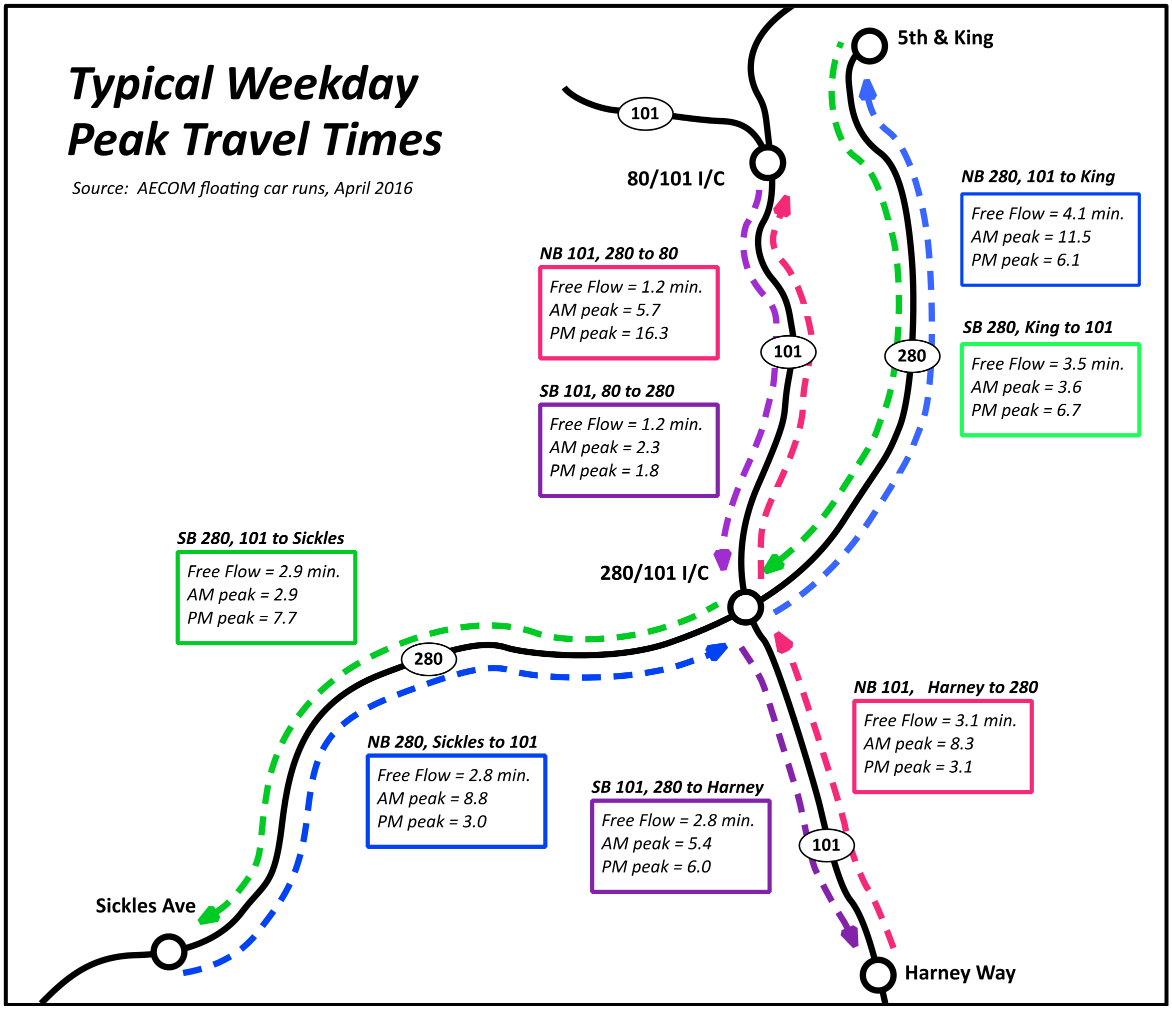
PM Conditions

<u>101</u>: During typical evening peak periods, traffic volumes entering southbound 101 are constrained at the Hospital Curve bottleneck ***(1)***, with queues frequently extending upstream onto the upper deck of the Bay Bridge. Conditions are generally free of congestion from the SF/SM County Line to the 380/101 interchange. Congestion regularly occurs south of 380/101 due to a bottleneck at the Millbrae interchange, but this queuing rarely extends into the project limits north of 380/101.

<u>280</u>: On I-280, minor congestion occurs approaching the Pennsylvania Avenue interchange indicating near-capacity traffic demands. South of the 280/101 interchange (and outside of the project limits), congestion typically occurs in the right lanes approaching the Alemany Boulevard and Monterey Boulevard off-ramps. However, this queuing does not extend upstream onto I-280 north of the 280/101 interchange and should not affect traffic within the project limits.

Figure 2

Figure 3


Typical Weekday
Peak Travel Times
Source: AECOM floating car runs, April 2016
101
80/101 I/C
5th & King
NB 280, 101 to King
Free Flow = 4.1 min.
AM peak = 11.5
PM peak = 6.1
NB 101, 280 to 80
Free Flow = 1.2 min.
AM peak = 5.7
PM peak = 16.3
101
280
SB 280, King to 101
Free Flow = 3.5 min.
AM peak = 3.6
PM peak = 6.7
SB 101, 80 to 280
Free Flow = 1.2 min.
AM peak = 2.3
PM peak = 1.8
SB 280, 101 to Sickles
Free Flow = 2.9 min.
AM peak = 2.9
PM peak = 7.7
280/101 I/C
280
NB 101, Harney to 280
Free Flow = 3.1 min.
AM peak = 8.3
PM peak = 3.1
NB 280, Sickles to 101
Free Flow = 2.8 min.
AM peak = 8.8
PM peak = 3.0
SB 101, 280 to Harney
Free Flow = 2.8 min.
AM peak = 5.4
PM peak = 6.0
101
Sickles Ave
Harney Way

FREEWAY MAINLINE VOLUMES and DEMANDS

As discussed above, an understanding of the controlling bottlenecks is key to performing a realistic assessment of the traffic impacts of any changes to the manner in which the freeway is operated. A high-level analysis was conducted of the controlling bottleneck locations (shown in Figure 2) to estimate the degree with which traffic demand exceeds the capacity of the bottlenecks. The methodology for this analysis is described in greater detail in Appendix D.

Bottleneck locations were first identified through floating car runs, and the capacities of the bottlenecks were estimated using PeMS data. Travel times and corresponding delays leading to each bottleneck were extracted from the floating car runs. The output and delay data were then used to compute hourly demand rates for each bottleneck (i.e. the number of vehicles per hour that exceed the capacity of the bottleneck, thus resulting in congestion). Peak hourly demands for freeway sections upstream and downstream of the bottlenecks were then calculated by adding and subtracting adjacent on and off-ramp volumes. Existing hourly peak period traffic volumes are presented in Tables 1 through 4, along with the estimated demands for the hours in which congestion occurs. In the "Demand" column, the estimated hourly "unconstrained" freeway demands (i.e. the number of vehicles that would appear at each freeway section if not constrained by other bottlenecks) are listed, with the controlling bottlenecks shown in ***red***. These estimated freeway mainline demands allow for (a) the identification of bottlenecks that may be "hidden" by queuing from a downstream bottleneck, or (b) new downstream bottlenecks that may appear if the controlling bottlenecks are relieved. The estimated existing demands will also be used to evaluate demand forecasts generated from the SF CHAMP model, and to establish the basis for analyzing the proposed alternatives in subsequent tasks.

Table 1

Existing Freeway Mainline Volumes (and Estimated Demands)

NORTHBOUND 101

	Morning Peak Period					Evening Peak Period				
	6:00-7:00 AM	7:00-8:00 AM		8:00-9:00 AM	9:00-10 AM	3:00-4:00 PM	4:00-5:00 PM	5:00-6:00 PM		6:00-7:00 PM
	Volume	Volume	Demand	Volume	Volume	Volume	Volume	Volume	Demand	Volume
380/101	7,598	9,017	9,017	8,999	7,866	6,917	7,354	7,295	7,295	7,199
South Airport off	6,864	7,963	7,963	7,527	6,749	6,278	6,763	6,732	6,732	6,690
South Airport on	6,964	8,459	8,459	8,192	7,104	6,372	6,889	7,187	7,187	7,076
Grand Ave off	6,012	7,154	7,154	6,650	5,927	5,958	6,436	6,684	6,684	6,649
Grand Ave on	6,532	7,722	7,722	7,136	6,380	6,562	7,117	7,201	7,224	7,285
Oyster Pt Blvd off	6,125	7,225	7,225	6,441	5,735	6,163	6,710	6,812	6,865	6,954
Oyster Pt Blvd on	6,652	8,021	8,021	7,144	6,308	6,908	7,766	8,030	8,151	7,773
Bayshore Blvd off	6,098	7,207	7,207	6,755	5,944	6,162	6,904	7,262	***7,427***	6,884
Sierra Pt off	6,002	7,035	7,035	6,435	5,641	6,087	6,820	7,181	7,346	6,805
Sierra Pt on	6,039	7,108	7,109	6,507	5,701	6,177	6,938	7,355	7,520	6,912
Harney Way off	5,907	6,975	7,008	6,393	5,541	6,016	6,515	7,202	7,367	6,837
Harney Way on	NA	7,294	7,347	6,703	NA	NA	6,660	7,339	7,504	NA
Third St off	NA	6,984	7,113	6,418	NA	NA	6,402	7,065	7,230	NA
Bayshore Blvd off	NA	6,825	6,994	6,193	NA	NA	6,067	6,707	6,872	NA
Bayshore Blvd on	NA	8,267	8,486	7,153	NA	NA	7,209	7,799	7,964	NA
280 NB/SB off	NA	4,702	4,971	3,445	NA	NA	3,328	3,834	3,834	NA

XXXX *Bottleneck Location & Estimated Demand , NA – Data not available*

Estimated demands based on bottleneck output

Table 2
Existing Freeway Mainline Volumes (and Estimated Demands)
SOUTHBOUND 101

	Morning Peak Period					Evening Peak Period				
	6:00-7:00 AM	7:00-8:00 AM		8:00-9:00 AM	9:00-10 AM	3:00-4:00 PM	4:00-5:00 PM	5:00-6:00 PM		6:00-7:00 PM
	Volume	Volume	Demand	Volume	Volume	Volume	Volume	Volume	Demand	Volume
San Bruno Ave off	NA	7,484	7,484	7,070	NA	NA	6,410	6,644	6644	NA
Bayshore Blvd off	NA	6,697	6775	6,568	NA	NA	6,239	6,159	6159	NA
3rd St on	NA	7,533	7689	7,485	NA	NA	6,373	6,845	6845	NA
Alanna Way off	NA	7,376	7592	7,291	NA	NA	6,227	6,695	6695	NA
Alanna Way on	6,511	7,652	***7,890***	7,560	6,859	5,986	6,432	6,880	6,880	6,868
Sierra Point off	6,396	7,502	7,502	7,354	6,661	5,809	6,246	6,678	6678	6,690
Sierra Point on	6,451	7,603	7,603	7,462	6,760	5,995	6,501	7,020	7020	6,881
Bayshore Blvd off	6,368	7,482	7,482	7,334	6,644	5,766	6,246	6,719	6719	6,637
Oyster Point off	5,534	6,435	6,435	6,174	5,820	5,760	5,864	5,831	5831	5,561
Airport Blvd on	6,172	7,491	7,491	7,211	6,676	6,984	6,980	6,731	6731	6,521
Oyster Point on	6,546	8,150	8,150	7,875	7,205	7,791	7,933	7,753	7753	7,247
Airport Blvd off	5,955	7,435	7,435	7,076	6,497	7,088	7,193	7,218	7218	6,711
Produce Ave off	5,563	7,120	7,120	6,789	6,323	6,672	7,000	7,102	7102	6,430
Produce Ave on	6,300	8,150	8,150	7,805	7,336	8,257	8,764	8,930	8930	7,669
I-380/US 101	5,657	6,445	6,445	5,804	5,776	6,420	6,241	6,074	6551	5,845

XXXX *Bottleneck Location & Estimated Demand , NA – Data not available*

(green shading) *Estimated demands based on bottleneck output*

Table 3

Existing Freeway Mainline Volumes

NORTHBOUND 280

	7:00-8:00 AM	8:00-9:00 AM	4:00-5:00 PM	5:00-6:00 PM
280/101	3,114	3,166	3,085	2,913
101 NB on	6,035	6,328	5,867	5,659
Cesar Chavez off	5,034	5,336	5,154	4,960
25th Street on	5,434	5,736	5,654	5,460
Mariposa off	4,167	4,075	4,968	4,845
18th Street on	4,242	4,219	5,097	4,957
6th Street off	2,061	2,106	3,240	3,195

Table 4

Existing Freeway Mainline Volumes

SOUTHBOUND 280

	7:00-8:00 AM	8:00-9:00 AM	4:00-5:00 PM	5:00-6:00 PM
Starting of Fwy	983	985	1,238	1,330
6th Street on	2,864	2,886	3,810	3,878
18th Street off	2,666	2,598	3,632	3,573
Mariposa on	3,178	3,129	4,809	4,724
Pennsylvania Ave off	2,813	2,749	4,309	4,209
Pennsylvania Ave on	3,461	3,368	5,512	5,203
US 101 SB off	1,423	1,442	3,168	2,899

Vehicle Classification and Occupancy rates

Average vehicle occupancy rates and the number of HOV-eligible vehicles are key factors in establishing the viability of a managed lane strategy and the parameters under which the managed lane would operate. To determine existing vehicle occupancy rates, manual peak period counts were conducted at ramps on SF-280 and weekday peak period volume and occupancy data for US-101 from the Bay Area Managed Lane Implementation Plan (MLIP) project, which was collected between March and mid-May of 2015, were obtained. No mid-day or off-peak vehicle occupancy data was available or collected for this study.

Based on the occupancy data gathered, an HOV definition of 2 or more persons per vehicle would result in about 20% to 25% of all vehicles qualifying to use a managed lane for free. Increasing the HOV definition to 3 or more persons per vehicle would reduce the percentage of HOV-eligible vehicles to between 3% to 10%. (Eligible users of high occupancy vehicle lanes include buses, vanpools, clean air vehicles, and motorcycles.) These statistics are very similar to occupancy rates observed on most Bay Area freeways.

Table 5: US 101 Vehicle Classification and Occupancy Summary (from MLIP)

US-101 AM (6:00-9:00 AM)	**SOV**	**HOV 2**	**HOV 3+**	**Van Pool**	**Clean Air**	**Buses**	**Truck**	**Motor cycle**	**2+ HOV%**	**3+ HOV%**
NB Mainline @ Third St.	16,173	2,968	150	88	-	151	1,131	118	17% (3,475)	2% (507)
NB Mainline @ Oyster Point	14,126	2,342	145	138	-	139	1,109	80	16% (2,844)	3% (502)
SB Mainline @ Third St.	15,420	1,885	111	114	-	193	713	114	13% (2,417)	3% (532)
SB Mainline @ San Bruno	11,245	1,178	57	28	-	165	615	74	11% (1,502)	2% (324)

US-101 PM (3:00-7:00 PM)	**SOV**	**HOV 2**	**HOV 3+**	**Van Pool**	**Clean Air**	**Buses**	**Truck**	**Motor cycle**	**2+ HOV%**	**3+ HOV%**
NB Mainline @ 23rd St	16,231	4,260	98	39	-	284	304	273	23% (4,954)	3% (694)
NB Mainline @ Third St	20,784	4,680	393	71	-	213	709	154	20% (5,510)	3% (830)
NB Mainline @ Oyster Point	19,882	4,713	287	140	-	201	553	204	21% (5,544)	3% (831)
SB Mainline @ Third St	17,715	4,925	276	84	-	136	811	140	23% (5,561)	3% (636)
SB Mainline @ San Bruno	12,474	2,816	182	54	-	86	474	111	20% (3,248)	3% (433)

Source: Bay Area Managed Lane Implementation Plan (MLIP) project, 2015

Table 6: I-280 Vehicle Classification and Occupancy Summary

I-280 AM (6:00-10:00 AM)	**SOV**	**HOV 2**	**HOV 3+**	**Van Pool**	**Clean Air**	**Bus**	**Truck**	**Motor cycle**	**2+ HOV%**	**3+ HOV%**
NB Off Ramp @ 5th & King	4,089	985	131	10	37	79	176	97	24% (1,339)	6% (354)
NB Off Ramp @ 6th & Brannan	5,238	1,258	175	38	132	138	228	82	25% (1,823)	8% (565)
SB On Ramp @ 5th & King	2,506	510	126	40	62	154	114	11	26% (903)	11% (393)
SB On Ramp @ 6th & Brannan	4,860	1,173	157	46	31	98	142	62	24% (1,567)	6% (394)
SB On Ramp @ Mariposa	1,400	218	34	8	14	23	84	5	17% (302)	5% (84)
SB On Ramp @ Cesar Chavez & Penn. St	1,598	206	36	5	10	145	359	4	17% (406)	8% (200)

I-280 PM (3:00-7:00 PM)	**SOV**	**HOV 2**	**HOV 3+**	**Van Pool**	**Clean Air**	**Bus**	**Truck**	**Motor cycle**	**2+ HOV%**	**3+ HOV%**
NB Off Ramp @5th & King	4,387	1,281	224	17	70	135	66	36	28% (1,763)	8% (482)
NB Off Ramp @ 6th & Brannan	4,948	1,677	428	51	144	52	75	83	33% (2,435)	10% (758)
SB On Ramp @ 5th & King	3,365	975	287	16	71	61	92	88	30% (1,498)	11% (523)
SB On Ramp @ 6th & Brannan	7,480	1,767	185	63	85	84	190	110	23% (2,294)	5% (527)
SB On Ramp @ Mariposa	3,441	564	78	5	9	15	46	35	17% (706)	3% (142)
SB On Ramp @ Cesar Chavez & Penn. St	3,341	474	48	4	13	29	183	26	14% (594)	3% (120)

Source: Manual field counts, May 2016

Note: 2+ HOV includes HOV 2, HOV 3, Clean Air Veh, Bus, VanPool and Motorcycles
3+ HOV includes HOV 3, Clean Air Veh, Bus, VanPool and Motorcycles

Accident & Incident Trends

This section discusses non-recurrent congestion, in terms of incidents and accidents, on the freeways within the study area. The study area extends from the northern part of San Mateo County on US 101 from the I-380 interchange into San Francisco County to the interchange with I-80, as well as I-280, from Geneva Avenue to the terminus at 5th/King. The project area that is within the study area is defined as the freeway corridor on US 101, from the interchange with I-380 to the interchange with I-280, and continues on I-280 (from the interchange with US 101) to the end of the freeway at 5th/King in San Francisco.

This high-level review and analysis of existing incident and accident data is to provide an understanding of non-recurrent congestion as caused by incidents or accidents that affect normal traffic flow and operations on the freeway facility. This will allow an assessment to be made regarding existing non-recurrent congestion in the study area, as well as how the design of future project alternatives may affect these conditions. Project alternatives may consider the reconfiguration of existing freeway lanes through re-striping or the use of shoulders to accommodate a managed lane, and therefore incidents and incident management activities involving the use of freeway shoulder areas under existing conditions, in particular, could be impacted by such reconfiguration. It must be noted, however, that this is NOT a safety review of the freeway corridors. It is recommended that a more detailed review be conducted during the subsequent planning and development stages for this project.

The discussion that follows is separated into two parts. Part one examines three years' worth of data (2013-2015) obtained from the Caltrans TMC activity logs that includes both incidents and accidents on US 101 and I-280. For the purpose of this project, incidents are defined as situations or conditions that affected the normal operation of the freeway other than traffic accidents. Examples of incidents include flooding of roadways or obstruction of roadways caused by debris on the freeways. Traffic accidents are traffic collisions as noted by the TMC operators in the activity log.

Part two focuses on the analysis of records obtained from the Traffic Accident Surveillance and Analysis System (TASAS), which is maintained by Caltrans. TASAS data from October 2011 through September 2014 for the two freeways within the study area was made available by Caltrans.

Though the TMC activity log is not an official data source like TASAS, it provides a more complete compilation of events that affected normal traffic flow and operations within the study area by recording both incidents and accidents. This allows for a more comprehensive understanding of existing conditions in terms of non-recurrent congestion. However, the level of detail available from the TMC logs can be limited at times since it is highly dependent on the amount of information recorded by the TMC operators for different purposes.

TMC Activity Log Data

Caltrans provided annual TMC activity log data from 2013 – 2015. Table 7 presents the number of incidents and accidents recorded over the 3-year period within the study area by freeway. It can be seen that the number of incidents occurring on the different freeways were fairly consistent over the 3-year period; about one recorded incident per day within the study area. The number of accidents fluctuates across the 3-year period, and even though the number of accidents in 2015 is higher than the two prior years, the sample size of three years is too small to conclude that accident occurrence is on the rise in the corridor.

Table 7: Number of Yearly Incidents and Accidents by Freeway

Year	Freeway	Direction	# of Incidents	# of Accidents	Total
2013	US 101 (SF)	NB	54	8	**62**
		SB	97	13	**110**
	US 101 (SM)	NB	27	0	**27**
		SB	22	1	**23**
	I-280 (SF)	NB	59	1	**60**
		SB	96	6	**102**
Total			**355**	**29**	**384**
2014	US 101 (SF)	NB	71	0	**71**
		SB	85	10	**95**
	US 101 (SM)	NB	21	0	**21**
		SB	19	1	**20**
	I-280 (SF)	NB	66	1	**67**
		SB	123	0	**123**
Total			**385**	**12**	**397**
2015	US 101 (SF)	NB	66	29	**95**
		SB	94	31	**125**
	US 101 (SM)	NB	18	0	**18**
		SB	17	0	**17**
	I-280 (SF)	NB	69	8	**77**
		SB	91	4	**95**
Total			**355**	**72**	**427**

Source: Caltrans District 4 TMC Activity Log

Tables 8 and 9 present the number of incidents and accidents, respectively, affecting the different lanes when they first occurred, while Table 10 further breaks down the type of incidents associated with the affected lanes. It can be seen that most incidents occur on the right-hand shoulder of the freeway, with more than 200 incidents during each of the three observed years. Most of these incidents were debris or objects obstructing the shoulder. It can be further inferred that some incidents happening in the general purpose lanes would likely be moved to the shoulder for incident response and clearance efforts. Incidents like car fires, stalled vehicles and objects obstructing travel lanes would be moved to the shoulder before the incident was cleared.

Over the three-year period, approximately 841 incidents occurred that affected one or more general purpose lanes and the left or right-hand shoulders. There were 184 incidents affecting the center divider over the three-year period, which were primarily obstructions caused by debris and objects. Flooding, as expected, usually happened during the wetter months of the year from November to February, with a few occurrences in March and April. Accidents usually affected at least one general purpose lane. Although the TMC activity log does not document accident severity and the detail for each record is limited, it can still be inferred that many of the accidents would also be moved to the shoulder during the course of incident response and clearance activities. As such, there were approximately 108 total accidents affecting one or more general purpose lanes and/or utilizing the shoulders during the three-year period. In total from the TMC activity log data, there were approximately 949 total incidents and accidents during the three-year analysis period that likely affected or utilized the shoulders, either because the incident/accident occurred on the shoulder itself, or because the shoulder was likely to be used for incident/accident response and clearance activities after the incident was moved out of the general purpose lanes. This information will be considered during the alternatives analysis to further assess the impacts that taking away shoulders on certain segments to provide for a managed lane may have on incident management activities and total non-recurrent delay in the corridor, as the data reviewed clearly shows that shoulders are currently utilized and/or impacted during less severe incidents, as well as during accidents.

Table 8: Number of INCIDENTS Affecting Different Lanes

		No. of lanes affected										
Year	Freeway	All lanes	1 GP lane	2 GP lanes	3 GP lanes	Not known	Left Shldr	Right Shldr	Center Divider	Off Ramp	On Ramp	Total
2015	US 101 (SF)	1	34	0	0	3	2	86	23	7	4	**160**
	US 101 (SM)	0	0	0	0	2	0	25	7	1	0	**35**
	I-280 (SF)	5	8	1	3	0	8	103	26	4	2	**160**
	Total	**6**	**42**	**1**	**3**	**5**	**10**	**214**	**56**	**12**	**6**	**355**
2014	US 101 (SF)	0	15	2	2	3	1	89	27	11	6	**156**
	US 101 (SM)	0	4	0	0	1	2	27	3	3	0	**40**
	I-280 (SF)	3	13	3	0	3	5	113	32	8	9	**189**
	Total	**3**	**32**	**5**	**2**	**7**	**8**	**229**	**62**	**22**	**15**	**385**
2013	US 101 (SF)	2	9	1	2	6	6	104	16	3	2	**151**
	US 101 (SM)	0	0	0	0	2	1	35	11	0	0	**49**
	I-280 (SF)	1	6	0	0	2	4	93	39	3	7	**155**
	Total	**3**	**15**	**1**	**2**	**3**	**11**	**232**	**66**	**6**	**9**	**355**

Source: Caltrans District 4 TMC Activity Log

Table 9: Number of ACCIDENTS Affecting Different Lanes

		No. of lanes affected										
Year	Freeway	All lanes	1 GP lane	2 GP lanes	3 GP lanes	Not known	Left Shldr	Right Shldr	Center Divider	Off Ramp	On Ramp	Total
2015	US 101 (SF)	3	41	7	4	2	0	1	1	0	1	**60**
	US 101 (SM)	0	0	0	0	0	0	0	0	0	0	**0**
	I-280 (SF)	2	6	3	0	0	0	0	0	1	0	**12**
	Total	**5**	**47**	**10**	**4**	**2**	**0**	**1**	**1**	**1**	**1**	**72**
2014	US 101 (SF)	1	2	3	2	0	0	1	0	1	0	**10**
	US 101 (SM)	1	0	0	0	0	0	0	0	0	0	**1**
	I-280 (SF)	1	0	0	0	0	0	0	0	0	0	**1**
	Total	**3**	**2**	**3**	**2**	**0**	**0**	**1**	**0**	**1**	**0**	**12**
2013	US 101 (SF)	5	4	5	6	0	0	0	0	1	0	**21**
	US 101 (SM)	0	0	1	0	0	0	0	0	0	0	**1**
	I-280 (SF)	2	1	1	1	1	0	1	0	0	0	**7**
	Total	**7**	**5**	**7**	**7**	**1**	**0**	**1**	**0**	**1**	**0**	**29**

Source: Caltrans District 4 TMC Activity Log

Table 10: Types of Incidents Affecting Freeway Lanes

No. of Lanes Affected	Types of Incidents	No. of Incidents			Total
		2015	2014	2013	
All	Flooding	4	1	1	**6**
	Car Fire	1	1	1	**3**
	Debris / Objects	0	0	1	**1**
	Blocked Veh	1	0	0	**1**
	Others	0	1	0	**1**
GP	Debris / Objects	5	7	6	**18**
	Others	0	0	4	**4**
1 (GP)	Stalled Veh	24	0	3	**27**
	Flooding	8	17	5	**20**
	Car Fire	2	0	0	**2**
	Pedestrian	0	1	0	**1**
	Debris / Objects	2	7	5	**14**
	Pothole	3	6	2	**11**
	Others	3	1	0	**4**
2 (GP)	Flooding	1	1	0	**2**
	Debris / Objects	0	1	0	**1**
	Pothole	0	1	0	**1**
	Others	0	2	1	**3**
3 (GP)	Flooding	3	0	0	**3**
	Stalled Veh	0	0	1	**1**
	Others	0	2	1	**3**
1 (LHS)	Debris / Objects	10	8	9	**27**
	Flooding	0	0	1	**1**
	Animal	0	0	1	**1**
1 (RHS)	Debris / Objects	205	228	216	**649**
	Car Fire	2	0	1	**3**
	Animal	3	0	9	**12**
	Flooding	1	1	0	**2**
	Pothole	1	0	0	**1**
	Others	2	0	6	**8**
Center Divider	Animal	3	1	6	**10**
	Debris / Objects	53	61	60	**174**
Off Ramp	Debris / Objects	8	7	5	**20**
	Flooding	0	8	0	**8**
	Pothole	0	2	0	**2**
	Animal	0	1	0	**1**
	Others	4	4	1	**9**
On Ramp	Car Fire	1	0	0	**1**
	Flooding	1	6	0	**7**
	Pothole	0	2	0	**2**
	Animal	0	0	1	**1**
	Debris / Objects	3	7	7	**17**
	Others	1	0	1	**2**
	Total	**355**	**385**	**355**	**1095**

Source: Caltrans District 4 TMC Activity Log

Tables 11 and 12 list the number of incidents and accidents, respectively, occurring during the peak and off-peak periods. Consistent with the rest of the report, the peak periods include the weekday AM Peak (6 AM – 10 AM) and PM Peak (3 PM – 7PM); all other times are considered off-peak periods. It can be seen that most incidents and accidents occurred outside of the peak periods even though the freeway carried more vehicles per hour during those times. A total of 337 incidents and 42 accidents occurred during the peak period over the three years versus a total of 758 incidents and 71 accidents that happened during the off-peak hours.

Table 11: Time of Incidents

No. of Lanes Affected	Time of Incidents	No. of Incidents			Total
		2015	2014	2013	
All	Peak	1	0	0	**1**
	Non Peak	5	3	3	**11**
GP	Peak	1	3	5	**9**
	Non Peak	4	4	5	**13**
1 (GP)	Peak	12	8	6	**26**
	Non Peak	30	24	9	**63**
2 (GP)	Peak	0	2	0	**2**
	Non Peak	1	3	1	**5**
3 (GP)	Peak	1	1	1	**3**
	Non Peak	2	1	1	**4**
1 (LHS)	Peak	6	3	1	**10**
	Non Peak	4	5	10	**19**
1 (RHS)	Peak	63	70	73	**206**
	Non Peak	151	159	159	**469**
Center Divider	Peak	19	17	24	**60**
	Non Peak	37	45	42	**124**
Off Ramp	Peak	4	3	3	**10**
	Non Peak	8	12	6	**26**
On Ramp	Peak	3	6	1	**10**
	Non Peak	3	16	5	**24**
	Total	**355**	**385**	**355**	**1095**

Source: Caltrans District 4 TMC Activity Log

Table 12: Time of Accidents

No. of Lanes Affected	Time of Accidents	No. of Incidents			Total
		2015	2014	2013	
All	Peak	2	0	1	3
	Non Peak	3	3	6	12
GP	Peak	1	0	0	1
	Non Peak	1	0	1	2
1 (GP)	Peak	28	0	1	29
	Non Peak	19	2	4	25
2 (GP)	Peak	1	1	1	3
	Non Peak	9	2	6	17
3 (GP)	Peak	1	0	3	4
	Non Peak	3	2	4	9
1 (LHS)	Peak	-	0	0	0
	Non Peak	-	0	0	0
1 (RHS)	Peak	1	0	0	1
	Non Peak	0	1	1	2
Center Divider	Peak	0	0	0	0
	Non Peak	1	0	0	1
Off Ramp	Peak	0	0	0	0
	Non Peak	1	0	0	1
On Ramp	Peak	0	0	1	1
	Non Peak	1	1	0	2
Total		**72**	**12**	**29**	**113**

Source: Caltrans District 4 TMC Activity Log

TASAS Data

This considers accident data available from the Caltrans' Traffic Accident Surveillance and Analysis System (TASAS). The timeframe for the data is from October 2011 to September 2014, which differs from the three calendar years used for the TMC activity log data presented above. The data collected by this system provides more accident detail, and the relevant information has been extracted and is summarized below. Table 13 lists the accident severity over the three-year period. It is noted that the number of accidents recorded by TASAS is significantly higher than that from the TMC activity logs, which is due to the fact that TASAS is the official accident record, whereas the TMC log information is used to supplement the TASAS data. It can be seen from Table 13 that the annual total number of accidents remained fairly consistent throughout the three-year period, and that most accidents involved property damage only. Fatal accidents are rare, with no more than five per year within the study area.

Table 13: Accident Severity and Persons Involved

Year	Freeway	Total Accident	Severity			Persons Involved	
			Fatal	Injury	PDO	Fatal	Injured
2013-2014	US 101 (SF)	586	1	186	399	1	242
	US 101 (SM)	292	1	137	154	1	200
	I-280 (SF)	250	1	100	149	1	147
	Total	**1128**	**3**	**423**	**702**	**3**	**589**
2012-2013	US 101 (SF)	571	0	164	407	0	242
	US 101 (SM)	277	1	101	175	1	140
	I-280 (SF)	298	1	106	191	1	165
	Total	**1146**	**2**	**371**	**773**	**2**	**547**
2011-2012	US 101 (SF)	531	3	181	347	3	253
	US 101 (SM)	273	1	102	170	1	149
	I-280 (SF)	284	1	133	150	1	196
	Total	**1088**	**5**	**416**	**667**	**5**	**598**

Source: TASAS
PDO – Property Damage Only
Years listed are from October to September of the following year

Table 14 below presents the types of collisions recorded. Rear end accidents were most common, followed by sideswipe and vehicles hitting objects. These accidents, in particular those that did not result in serious injury or fatality, would most likely be moved to the shoulders to relieve the affected travel lanes.

Table 14: Accident Severity and Persons Involved

Year	Freeway	Collision Type									Total
		Head On	Side-swipe	Rear End	Broad-side	Hit Object	Over-turn	Auto-Ped	Others	Not Stated	
2013-2014	US 101 (SF)	1	144	360	6	55	11	1	3	5	**586**
	US 101 (SM)	4	74	116	7	75	12	0	2	2	**292**
	I-280 (SF)	1	55	130	8	44	8	2	0	2	**250**
	Total	**6**	**273**	**606**	**21**	**174**	**31**	**3**	**5**	**9**	**1128**
2012-2013	US 101 (SF)	3	137	346	7	61	7	1	4	5	**571**
	US 101 (SM)	4	60	134	5	62	7	1	2	2	**277**
	I-280 (SF)	2	65	140	3	80	2	1	4	1	**298**
	Total	**9**	**262**	**620**	**15**	**203**	**16**	**3**	**10**	**8**	**1146**
2011-2012	US 101 (SF)	2	117	318	8	72	4	3	4	3	**531**
	US 101 (SM)	0	63	125	6	64	9	0	6	0	**273**
	I-280 (SF)	2	56	142	7	63	5	4	4	1	**284**
	Total	**4**	**236**	**585**	**21**	**199**	**18**	**7**	**14**	**4**	**1088**

Source: TASAS

Table 15 shows the lanes or freeway areas affected by the accidents when they first occurred. It should be noted that one accident can affect more than one lane or area. As such, the number presented in Table 15 indicates the number of times a lane or an area is affected rather than the actual number of accidents. It can be seen that the most accidents affected the interior lanes. This is consistent with the observation from the TMC log data where accidents generally affected the general purpose lanes. However, as discussed above, it is highly probable that most of the accidents, particularly the property damage only occurrences, would be moved to the shoulder during the course of incident management activities and clearance. As such, the shoulders would be affected more frequently than the number indicated by the data shown in Table 15.

Table 15: Freeway Lanes and Areas Affected by Accident

Year	Freeway	Beyond Median or Stripe-Left	Beyond Shoulder Drivers Left	Left Shoulder Area	Left Lane	Interior Lanes	Right Lane	Right Shoulder Area	Beyond Shoulder Drivers Right	Gore Area	Others	Does not Apply	Total
2013-2014	US 101 (SF)	0	23	2	213	288	111	5	19	7	3	174	845
	US 101 (SM)	1	34	0	64	119	73	2	37	1	5	61	397
	I-280 (SF)	1	22	1	50	88	98	2	18	1	4	53	338
	Total	**2**	**79**	**3**	**327**	**495**	**282**	**9**	**74**	**9**	**12**	**288**	**1580**
2012-2013	US 101 (SF)	1	31	1	154	294	141	4	20	0	6	145	797
	US 101 (SM)	0	32	2	72	105	68	2	22	1	4	55	364
	I-280 (SF)	2	43	0	50	100	104	3	30	0	5	71	408
	Total	**3**	**106**	**3**	**276**	**499**	**313**	**9**	**72**	**1**	**15**	**271**	**1568**
2011-2012	US 101 (SF)	4	37	0	140	256	130	4	23	0	7	133	734
	US 101 (SM)	0	24	2	69	127	60	1	26	0	1	77	387
	I-280 (SF)	0	33	0	61	91	98	1	31	0	2	72	389
	Total	**4**	**94**	**2**	**270**	**474**	**288**	**6**	**80**	**0**	**10**	**282**	**1510**

Source: TASAS

Table 16 shows the time (peak vs non-peak) when the accidents occurred. The peak period refers to the same 6-10 AM and 3-7 PM hours used throughout this report. All other times outside of the two periods are considered non-peak. The TASAS data shows a different observation from the TMC activity log data. Table 10 shows that more accidents occurred during the AM and PM peak periods compared to the off peak period. This is likely due to the inclusion of the weekend accident numbers during the 6-10 AM and 3-7 PM timeframe. Due to the format of the data provided, it is not possible to segregate the weekend accident numbers from the weekdays.

Table 16: Time of Accidents

Year	Freeway	Accident Time		Total
		Peak hours	Non Peak hours	
2013-2014	US 101 (SF)	313	273	**586**
	US 101 (SM)	144	148	**292**
	I-280 (SF)	140	110	**250**
	Total	**597**	**531**	**1128**
2012-2013	US 101 (SF)	305	266	**571**
	US 101 (SM)	131	146	**277**
	I-280 (SF)	169	129	**298**
	Total	**605**	**541**	**1146**
2011-2012	US 101 (SF)	273	258	**531**
	US 101 (SM)	150	123	**273**
	I-280 (SF)	162	122	**284**
	Total	**585**	**503**	**1088**

Source: TASAS

LOCAL STREETS

In view of the high volume carried by the two study freeways, the interface of the freeways with local streets are of paramount importance. Available information on local streets from official sources is compiled in this section to document existing performance, and to provide the basis for performing a high-level assessment of potential safety and operational impacts on nearby streets due to the implementation of a managed lane on the freeway.

Parallel Major Arterials

The major arterials in the study area that parallel the US 101 and I-280 corridors include: 3rd Street, Bayshore Boulevard, Alemany Boulevard, Potrero Avenue, San Jose Avenue, Junipero Serra Boulevard, Ocean Avenue, Monterey Boulevard, Airport Boulevard, Gateway Boulevard, and El Camino Real. Current configurations of each arterial are described in further detail below.

Third Street serves as a major non-freeway north-south arterial, connecting the study area with major destinations to the north, such as downtown San Francisco and AT&T Park, with two mixed-flow travel lanes and one exclusive light rail lane for the T-Third Street Muni Metro in each direction; however, due to the limited right-of-way, T-Third operates on a second mixed-flow lane for the 3/5-mile stretch between Kirkwood and Shafter streets. Short blocks, wide sidewalks, parking lanes, a landscaped median, and light rail stations make this street accessible to drivers, pedestrians, and transit riders. The lack of space for a dedicated bike lane can create bicycle/vehicle conflicts during busy traffic times.

Bayshore Boulevard carries two auto travel lanes and a dedicated bicycle lane in each direction in San Francisco. One stretch of this portion, from Sunnydale Avenue to Third Street, also carries a dedicated light rail lane in each direction. Bayshore Boulevard provides access to US 101 at Third Street. Portions of the street feature parking on both sides. A landscaped median, attractive lighting and light rail stations help give the street a multimodal orientation. But at the Third Street/US 101 ramp intersection, the freeway on-ramps, off-ramps, and diverging streets can make navigating the area difficult for all modes. North of Third Street, Bayshore Boulevard runs parallel to US 101 and experiences heavier vehicle traffic than the portion south of Third Street, impacting its intersections with east-west streets.

In San Mateo County, Bayshore Boulevard continues south of Sunnydale Avenue with two travel lanes and a dedicated bicycle lane in each direction. Bayshore Boulevard’s name changes to Airport Boulevard at the southbound on- and off-ramps located about 1500’ north of the Oyster Point Boulevard intersection with Airport Boulevard. There is only one lane plus the bicycle lane on northbound Bayshore Boulevard between these ramps and the end of the flyover off-ramp from northbound US 101.

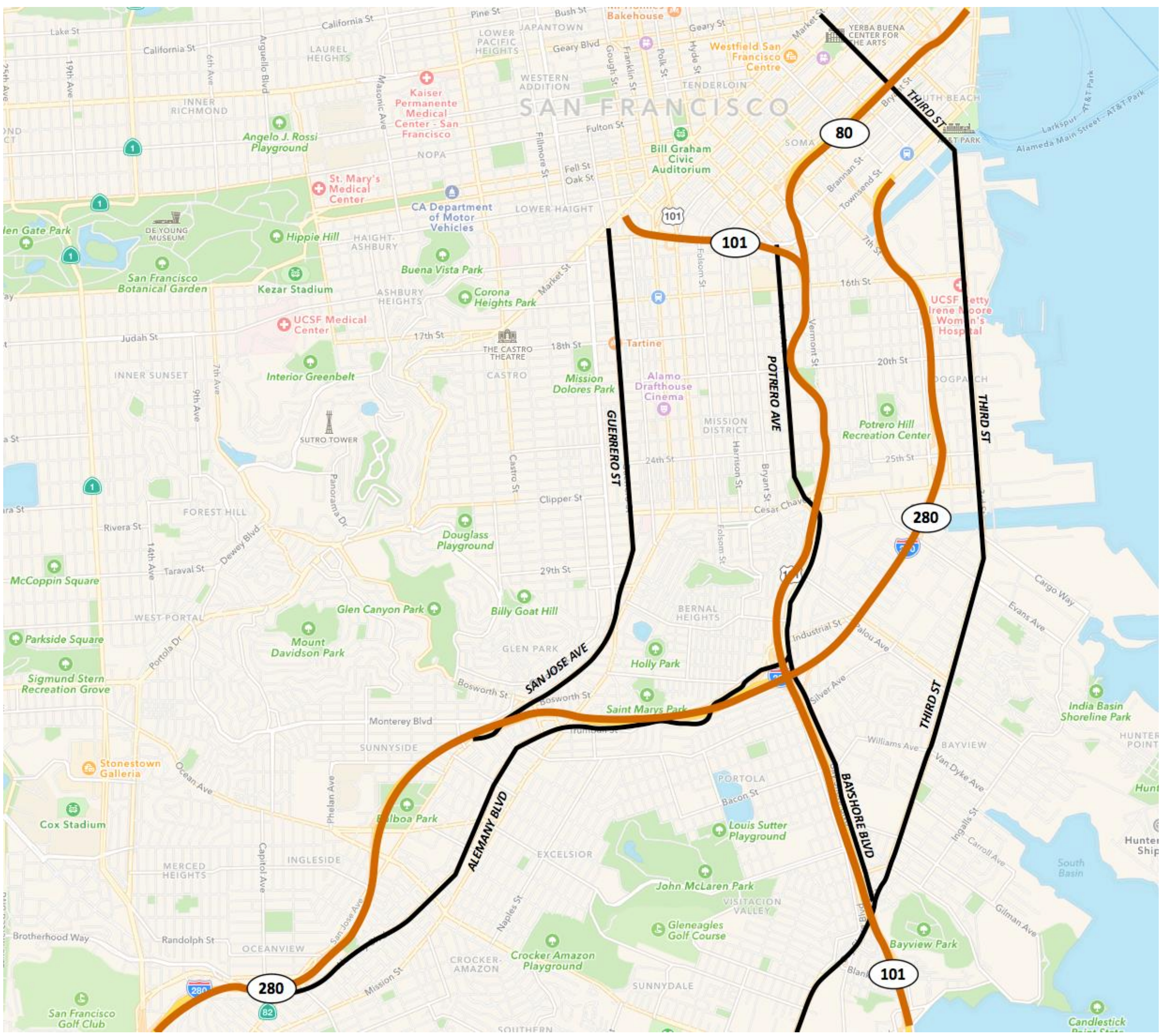
Alemany Boulevard is a northeast-southwest arterial in San Francisco. It starts at Bayshore Boulevard, near the intersection of I-280 and US 101. The eastbound and westbound lanes split beneath the interchange, allowing for access ramps to US 101 from the middle. To the west, the road again splits, with I-280 running in the middle. The split ends at Congdon Street and roadway continues south of I-280 until it reaches San Jose Avenue where it then continues west.

Potrero Avenue is a north-south arterial that runs parallel to US 101. It begins at Bayshore Boulevard, at the intersection of Cesar Chavez Street and US 101. The road continues north and ends at Division

Street, below the US 101 and I-80 connector ramps. Potrero Avenue carries two auto travel lanes, a dedicated bike lane and parallel parking in each direction, as well as a center turning lane.

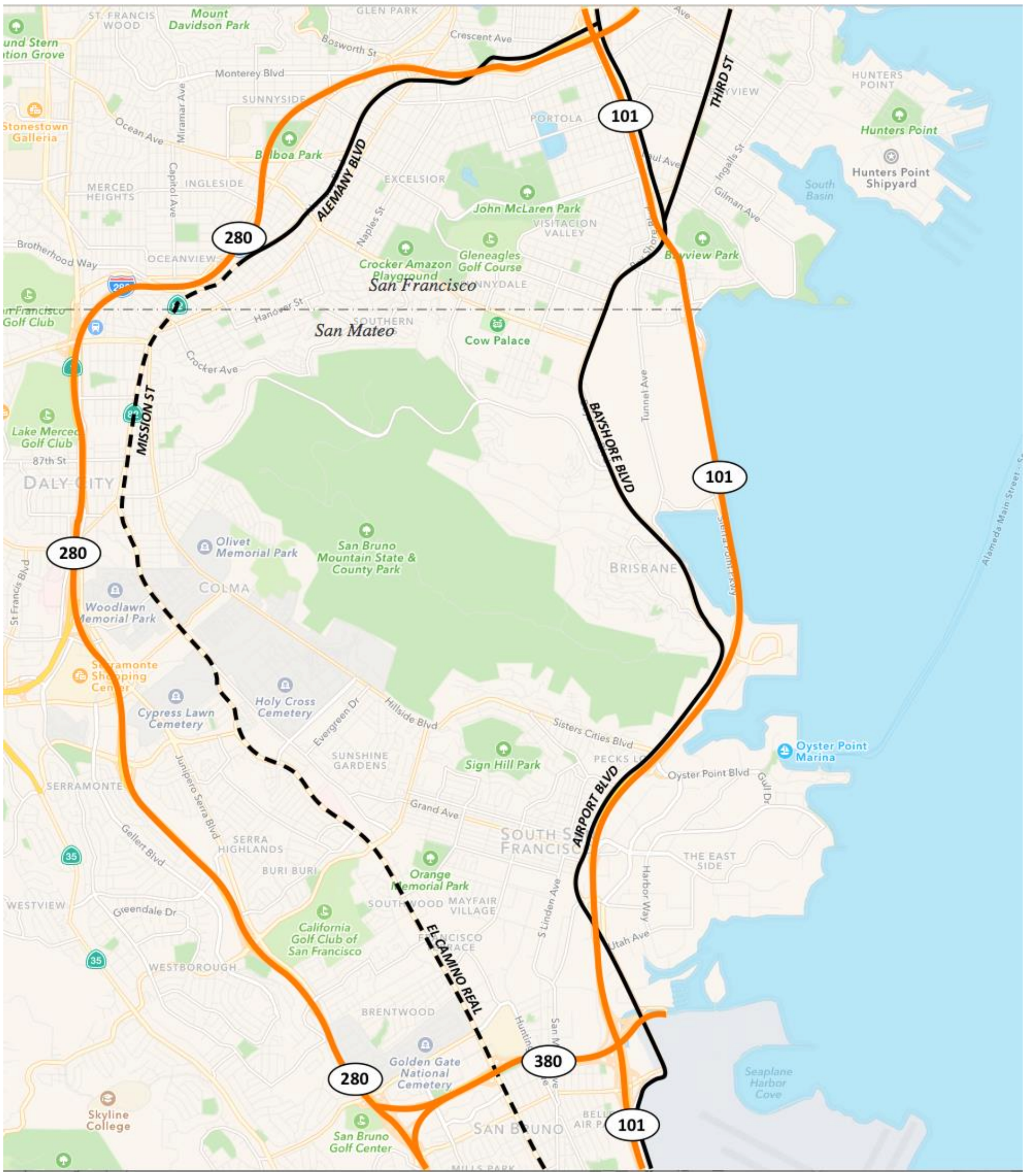
San Jose Avenue and Guerrero Street form a northeast-southwest arterial in San Francisco carrying two auto lanes in each direction. It begins as part of Route 82 at the John Daly Boulevard and Mission Street intersection. After crossing Alemany Boulevard, the eastbound and westbound lanes split beneath the I-280 interchange, connecting the southbound off-ramp to the westbound lanes. The road merges at Broad Street, where the San Francisco Municipal Railway (Muni) enters the median and remains there until it reaches 30th Street. At Monterey Boulevard, San Jose Avenue crosses beneath the I-280 interchange, allowing northbound off-ramp access to the eastbound lanes and southbound on-ramp access to the westbound lanes. San Jose Avenue ends near Cesar Chavez Street and Guerrero Street begins. Guerrero Street carries two auto lanes in each direction, running parallel to US 101, and ends at Market Street.

Figure 4: Major Parallel Arterials in San Francisco



Airport Boulevard is the southern extension of Bayshore Boulevard as described above. From its beginning, it continues on the west side of US 101 until it crosses over the freeway to the east side and an intersection with Gateway Boulevard. At this intersection, it becomes South Airport Boulevard and turns south as the southern extension of Gateway Boulevard. South Airport Boulevard exits the study area at I-380. South of 380, Gateway Boulevard can be accessed from US 101 via an interchange at San Bruno Avenue. South Airport Boulevard carries two auto travel lanes and a dedicated bicycle lane in each direction from its beginning as the continuation of Bayshore Boulevard to its intersection with Miller Ave. There is a short stretch where there is no southbound bicycle lane near the Oyster Point Boulevard intersection. South of Miller Avenue, Airport Boulevard becomes three auto lanes in each direction with no bicycle lane to the point where it crosses over US 101. Beyond this point, Airport Boulevard reverts to two auto lanes in each direction with no bicycle lanes.

Figure 5: Major Parallel Arterials in San Mateo County



Gateway Boulevard extends on the east side of US 101 from Oyster Point Boulevard to Airport Boulevard. Gateway Boulevard has two auto travel lanes in each direction for its entire length. There are bicycle lanes in each direction between East Grand Avenue and Airport Boulevard.

El Camino Real within the study area runs north from I-380 to Daly City. It could provide an alternate route to San Francisco for travelers on US 101, though this would involve out of direction travel. El Camino has three auto travel lanes in each direction within the study area.

STREET PERFORMANCE DATA

San Francisco Major Arterials and Intersections within study area

Table 17 summarizes traffic performance for 11 arterials in the vicinity of the San Francisco portion of the study corridors. This data was extracted from the 2015 SF Congestion Management Program (CMP) report, and describe AM and PM peak average speeds and level of service in the years 2009, 2011, 2013 and 2015. This information will be compared with street performance metrics that will be generated from the SF CHAMP forecast model for the project alternatives being studied.

Of the key arterials that parallel the freeways in San Francisco, the CMP data for Bayshore Boulevard and Potrero Avenue indicate a worsening of performance since 2013. Conditions on 3rd Street and Guerrero Street appear to operate at LOS D or better during peak periods.

In addition to the statistics from the San Francisco CMP, a variety of traffic studies have been conducted in recent years for development projects in the South of Market area. Data from one of these studies, the Pier 70 Mixed-Use District Project Transportation Impact Study, includes existing intersection performance information for numerous intersections in the vicinity of I-280. Level of service results from that study are shown in Table 18.

Table 17: San Francisco Arterial LOS and Speed

Street	From	To	Direction	LOS & Speed Range															
				2009				2011				2013				2015			
				AM		PM		AM		PM		AM		PM		AM		PM	
3rd St	Jamestown	Market	NB	B-C	28.4-19.9	A-C	30.1-15.7	B-D	27.6-15.0	A-D	30.0-12.3	C	20.9-18.1	C	20.4-17.8	C-D	17.5-17.1	C-D	17.8-14.1
	Terry Francois	Jamestown	SB	B	28.6-23.2	B	27.8-22.3	A-B	27.3-25.4	B	29.5-22.7	B-C	21.7-19.2	C	20.5-18.7	C	18.7-18.4	C-D	17.5-16.6
16th St	Market	Potrero	EB	C-D	14.1-12.1	D	12.8-10.7	C	13.7-13.6	D	11.9-11.7	C	16.3-14.7	C	14.9-14.8	C	13.3-13.1	C-D	13.5-11.9
	Potrero	Market	WB	C	13.5-13.4	C-D	15.2-12.3	D	12.7-12.1	C-E	13.4-8.4	C	16.0-14.1	C-D	17.0-12.5	C	13.3-13.0	D	11.7-11.1
Alemany Blvd	County Line	Bayshore	EB	B-C	28.3-26.1	B-C	29.9-22.4	B-C	28.5-23.2	B-C	30.2-22.0	B	29.7	B	33.0	C	22.3	B	29.2
	Bayshore	County Line	WB	B-C	30.7-25.3	B-C	31.4-22.2	B-D	28.1-21.4	C	24.7-22.5	B-C	29.8-25.9	B	31.2-29.6	B-C	31.2-22.4	C	27.6-22.2
Bayshore Blvd	County Line	Cesar Chavez	NB	D	17.5-17.4	C-D	21.5-14.4	C-**E**	19.1-12.6	C-D	23.1-15.5	D-**E**	15.8-13.9	C-D	23.1-17.6	D-**E**	16.2-10.8	C-D	20.2-17.3
	Cesar Chavez	County Line	SB	B	27.8-25.4	B-C	26.3-22.3	B-C	24.1-19.4	C-D	21.8-15.3	B	24.5	B	25.5	C	22.5	C	20.6
Cesar Chavez	Guerrero	3rd	EB	B-C	21.3-17.5	A-C	30.8-13.5	B-C	24.3-14.6	B-D	24.0-10.7	-		-		-		-	
	3rd	Guerrero	WB	B-D	22.2-10.9	A-C	25.7-13.7	B-D	23.6-11.2	A-**E**	26.9-8.0	-		-		-		-	
Geneva Ave	Ocean	Santos	EB	C-**E**	23.8-8.8	B-**E**	28.5-8.4	B-D	29.7-11.9	B-D	24.8-11.5	C	14.7-13.8	C	14.4-14.2	D	11.7-10.9	D	10.7-9.6
	Santos	Ocean	WB	B-**E**	24.5-8.2	B-D	27.7-9.2	C-**E**	27.1-8.7	B-**E**	25.6-8.1	C-D	13.6-12.9	C	13.2-13.1	D	10.7-10.2	D	10.8-9.7
Guerrero / San Jose	Monterey	Cesar Chavez	NB	B-D	27.5-21.3	B-**E**	30.4-14.2	D	26.2-10.2	C-**E**	30.9-12.7	C	17.1	C	18.9	C	15.1	C	14.1
	Cesar Chavez	Monterey	SB	B-**E**	41.6-16.6	B-**F**	41.9-12.1	B-D	38.7-12.2	B-**E**	38.2-15.0	B	20.7	C	18.7	C	15.6	D	12.7
Junipero Serra	County Line	Sloat	NB	B-D	40.0-22.1	B-**F**	35.6-15.2	A-**F**	44.1-10.8	A-**F**	47.1-10.5	C-**E**	27.0-12.8	C-**E**	26.0-13.8	C-**E**	27.0-13.1	D-**E**	20.8-12.9
	Sloat	County Line	SB	A-D	43.5-17.8	B-**E**	39.6-16.7	A-D	44.1-21.4	A-**E**	45.3-16.8	A-C	49.0-25.3	A-C	50.6-26.3	A-D	48.7-21.6	A-D	48.9-18.5
Market / Portola	Sloat	Drumm	EB	B-D	29.8-12.5	C-**F**	24.0-9.5	B-**F**	28.7-7.0	B-**E**	24.5-10.3	D	12.3	D	11.9	D	10.1	**E**	8.9
	Drumm	Sloat	WB	B-**E**	25.9-10.4	A-**F**	26.9-8.3	A-**E**	28.0-12.1	A-**E**	31.4-10.9	C	13.1	D	11.7	D	11.8	D	9.4
Ocean Ave	19th	Howth	EB	C-D	18.7-11.1	C-D	14.8-12.9	C-D	13.9-11.4	D	12.8-12.7	C	15.0-14.1	C	14.2-13.8	C-D	14.5-11.9	C-D	13.8-11.1
	Howth	19th	WB	C-D	14.8-11.1	D	13.0-12.3	C	15.8-14.6	C-D	14.5-11.9	C	14.3-13.4	C-D	14.2-12.5	C-D	13.3-11.4	C-**E**	13.1-8.6
Potrero Ave	Cesar Chavez	21st	NB	B	22.5-21.2	C	18.8-15.6	B	24.3-23.5	B	23.2-21.3	C	19.0-15.2	C	15.3-15.1	B-D	19.5-10.4	**E**	7.7-6.3
	21st	Cesar Chavez	SB	B	23.9-22.0	A-B	25.2-19.4	B	23.3-19.0	B-C	22.6-18.0	B-C	19.2-17.2	C-**E**	14.0-8.5	C	14.5-14.4	**E-F**	8.5-3.9

Source: SF CMP

Table 18: Peak Hour Intersection Level of Service

Intersection		Traffic Control	AM Peak Hour		PM Peak Hour	
			Delay[1]	LOS[2]	Delay[1]	LOS[2]
1.	King Street / Third Street	Signal	40	D	**79**	**E**
2.	King Street / Fourth Street	Signal	39	D	52	D
3.	King Street / Fifth Street / I-280 Ramps	Signal	**58**	**E**	37	D
4.	Third Street / Harrison Street	Signal	27	C	32	C
5.	Third Street / Bryant Street	Signal	24	C	**57**	**E**
6.	Sixth Street / Brannan Street / I-280 Ramps	Signal	39	D	**>80**	**F**
7.	Third Street / Terry A. Francois Boulevard	Signal	15	B	12	B
8.	Third Street / Channel Street	Signal	37	D	27	C
9.	Third Street / Mission Rock Street	Signal	37	D	21	C
10.	16th Street / Third Street	Signal	24	C	22	C
11.	16th Street / Owens Street	Signal	12	B	21	C
12.	16th Street / Seventh Street / Mississippi Street	Signal	24	C	35	D
13.	Mariposa Street / Terry A. Francois Blvd. / Illinois St.	AWSC	22 (EB)	C	10 (SB)	B
14.	Mariposa Street / Third Street	Signal	35	D	26	C
15.	Mariposa Street / I-280 NB Off-Ramp	Signal	**61**	**E**	23	C
16.	Mariposa Street / I-280 SB On-Ramp	SSSC	11 (EB)	B	**>50 (EB)**	**F**
17.	18th Street / I-280 Northbound On-Ramp	SSSC	1 (EB)	A	1 (EB)	A
18.	18th Street / I-280 Southbound Off-Ramp	SSSC	13 (SB)	B	13 (SB)	B
19.	18th Street / Texas Street	SSSC	12 (SB)	B	16 (SB)	C
20.	18th Street / Arkansas Street	AWSC	8 (NB)	A	8 (SB)	A
21.	19th Street / Illinois Street	SSSC	10 (EB)	B	10 (EB)	B
22.	20th Street / Illinois Street	AWSC	9 (NB)	A	9 (NB)	A
23.	20th Street / Third Street	Signal	15	B	13	B
24.	21st Street / Illinois Street (future)	-	-	-	-	-
25.	22nd Street / Illinois Street	AWSC	9 (NB)	A	9 (NB)	A
26.	22nd Street / Third Street	Signal	7	A	9	A
27.	22nd Street / Tennessee Street	SSSC	12 (NB)	B	12 (SB)	B
28.	22nd Street / Indiana Street	AWSC	8 (EB)	A	8 (WB)	A
29.	23rd Street / Illinois Street	SSSC	12 (EB)	B	12 (WB)	B
30.	23rd Street / Third Street	Signal	10	A	11	B
31.	25th Street / Illinois Street	Signal	8	A	9	A
32.	25th Street / Third Street	Signal	14	B	13	B
33.	Cesar Chavez Street / Third Street	Signal	25	C	38	D
34.	25th Street / Indiana Street / I-280 Northbound On-Ramp	AWSC	10 (EB)	A	13 (WB)	B
35.	25th Street / Pennsylvania Street	AWSC	16 (SB)	C	31 (SB)	D
36.	Pennsylvania Street / I-280 Southbound Off-Ramp	AWSC	14 (SB)	B	18 (SB)	C
37.	Pennsylvania Street / I-280 Southbound On-Ramp	SSSC	5 (SB)	A	5 (SB)	A
38.	Cesar Chavez Street / Pennsylvania Street / I-280 NB Off	Signal	42	D	49	D

Notes: **Bold** indicates intersection operations at LOS E or LOS F. AWSC = all-way stop control. SSSC = side-street stop control.

1. Average delay reported as seconds per vehicle.
2. For signalized intersections, LOS based on average intersection delay calculated using 2000 HCM methodology. For unsignalized intersections, LOS based on worst approach (indicated in parentheses).

Source: Fehr & Peers, 2015.

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SAN FRANCISCO PLANNING DEPARTMENT

Pier 70 Mixed-Use District Project Transportation Impact Study
Preliminary Draft 2 – Subject to Review, Not Reviewed for Accuracy

San Mateo Major Arterials and Intersections within study area

According to the 2015 San Mateo CMP report, the two CMP intersections within the study area, namely Bayshore /Geneva and SR 82 / John Daly Blvd, operated within acceptable LOS of D or better from 2009 to 2015 during both peak periods (see Table 19). Traffic volumes on major arterials and key intersections were collected as part of the June 2016 San Mateo County US 101 Ramp Metering Project “After” Study, and are summarized in Tables 20 through 22.

Table 19: San Mateo Intersection LOS

Intersection	Standard LOS	2009		2011		2013		2015	
		AM	PM	AM	PM	AM	PM	AM	PM
Bayshore / Geneva	E	C	C	B	B	B	B	B	B
SR 82 / Hillside / John Daly Blvd	E	C	D	B	C	C	C	C	C

Source: San Mateo CMP

Table 20: Volumes on Major Arterials in San Mateo County (AM)

Arterial	Between	Direction	Volumes	6-7 AM	7-8 AM	8-9 AM	9-10 AM	Total
Bayshore Blvd	Geneva Ave	NB	'Before' RM	305	478	530	411	**1724**
			'After' RM	723	914	875	793	**3305**
	Tunnel Ave	SB	'Before' RM	65	65	65	65	**260**
			'After' RM	365	564	581	511	**2021**
Airport Blvd	Grand Ave	NB	'Before' RM	88	177	176	136	**577**
			'After' RM	296	486	455	287	**1524**
	Oyster Pt Blvd	SB	'Before' RM	160	270	338	273	**1041**
			'After' RM	177	281	372	301	**1131**
Gateway Blvd	E Grand Ave	NB	'Before' RM	229	394	490	312	**1425**
			'After' RM	240	372	511	392	**1515**
	S Airport Blvd	SB	'Before' RM	56	56	56	56	**224**
			'After' RM	172	267	331	356	**1126**
Gateway Blvd	Oyster Pt Blvd	NB	'Before' RM	140	253	323	266	**982**
			'After' RM	153	307	389	350	**1199**
	E Grand Ave	SB	'Before' RM	245	479	634	377	**1735**
			'After' RM	208	318	453	375	**1354**
S Airport Blvd	Utah Ave	NB	'Before' RM	270	599	951	581	**2401**
			'After' RM	388	743	1193	718	**3042**
	N Access Rd	SB	'Before' RM	292	448	490	539	**1769**
			'After' RM	310	402	470	541	**1723**

Source: San Mateo County US 101 Ramp Metering Project Final Report (2016)
RM = Ramp Metering

Table 21: Volumes on Major Arterials in San Mateo County (PM)

Arterial	Between	Direction	Volumes	3-4 PM	4-5 PM	5-6 PM	6-7 PM	Total
Bayshore Blvd	Geneva Ave	NB	'Before' RM	657	770	999	830	**3256**
			'After' RM	821	875	974	866	**3536**
	Tunnel Ave	SB	'Before' RM	65	65	65	65	**260**
			'After' RM	612	731	789	707	**2839**
Airport Blvd	Grand Ave	NB	'Before' RM	203	217	296	238	**954**
			'After' RM	355	371	469	405	**1600**
	Oyster Pt Blvd	SB	'Before' RM	287	326	383	280	**1276**
			'After' RM	422	490	552	428	**1892**
Gateway Blvd	E Grand Ave	NB	'Before' RM	207	208	236	234	**885**
			'After' RM	307	309	323	331	**1270**
	S Airport Blvd	SB	'Before' RM	56	56	56	56	**224**
			'After' RM	574	713	770	547	**2604**
Gateway Blvd	Oyster Pt Blvd	NB	'Before' RM	401	658	761	396	**2216**
			'After' RM	389	570	687	442	**2088**
	E Grand Ave	SB	'Before' RM	182	200	234	119	**735**
			'After' RM	233	275	299	189	**996**
S Airport Blvd	Utah Ave	NB	'Before' RM	492	491	518	471	**1972**
			'After' RM	595	657	752	724	**2728**
	N Access Rd	SB	'Before' RM	895	1208	1410	901	**4414**
			'After' RM	929	1161	1284	871	**4245**

Source: San Mateo County US 101 Ramp Metering Project Final Report (2016)
RM = Ramp Metering

Table 22: Volumes at Major Intersections in San Mateo County (PM)

These volumes are the average of the week 1 and week 2 volumes for the 'before' and 'after' ramp metering.

Intersection	Avg AM Peak Hour Volumes	NB	SB	EB	WB	Total
Alanna Way / Beatty Ave	'Before RM'	43	159	243	179	**622**
	'After RM'	55	204	273	173	**705**
Lagoon Rd / Sierra Pt Pkwy	'Before RM'	82	250	103	0	**434**
	'After RM'	85	192	130	0	**407**
Marina Blvd / Sierra Pt Pkwy	'Before RM'	70	19	492	25	**605**
	'After RM'	75	16	518	21	**630**
Airport Blvd / Oyster Pt	'Before RM'	451	669	1371	352	**2841**
	'After RM'	559	742	1367	261	**2929**
US 101 NB On-Ramp / Oyster Pt	'Before RM'	854	0	1788	509	**3150**
	'After RM'	674	0	1953	585	**3212**
Dubuque Ave / US 101 NB Off-Ramp	'Before RM'	73	713	874	8	**1667**
	'After RM'	75	803	617	2	**1497**
Gateway Blvd / Oyster Blvd	'Before RM'	287	0	2348	434	**3069**
	'After RM'	315	0	1316	394	**2025**
Airport Blvd / Grand Ave	'Before RM'	537	885	378	392	**2191**
	'After RM'	598	949	400	354	**2301**
Airport Blvd-Produce Ave / San Mateo Ave-S Airport Blvd	'Before RM'	543	877	303	566	**2288**
	'After RM'	528	922	370	639	**2458**
Gateway Blvd-S Airport Blvd /S. Airport Blvd-Mitchell Ave	'Before RM'	1109	246	604	125	**2084**
	'After RM'	1137	270	657	158	**2221**
S. Airport Blvd / US 101 NB Ramps	'Before RM'	441	467	1314	29	**2251**
	'After RM'	447	535	1271	29	**2281**
Airport Blvd / US 101 & I-380 Ramps	'Before RM'	827	445	0	352	**1624**
	'After RM'	1067	546	0	208	**1821**
El Camino Real / I-380 EB Ramp	'Before RM'	1525	2101	402	0	**4027**
	'After RM'	1594	1318	394	0	**3305**

Source: San Mateo County US 101 Ramp Metering Project Final Report (2016)

Freeway Connections to Local Streets

The locations of local street and freeway interfaces within the San Francisco portion of the study area are shown in Figure 6 and listed in Tables 23 and 24 for US 101 and I-280, respectively. Within this area, the US 101 corridor has 4 on-ramps and 7 off-ramps in the northbound direction, as well as 5 on-ramps and 9 off-ramps in the southbound direction. The I-280 corridor has 8 on-ramps and off-ramps in the northbound direction, as well as 8 on-ramps and 9 off-ramps in the southbound direction. The tables below list the local on and off ramps, peak hour ramp volumes (where data was available), as well as the intersection control type.

Figure 6: Freeway Interfaces with Local Streets in San Francisco

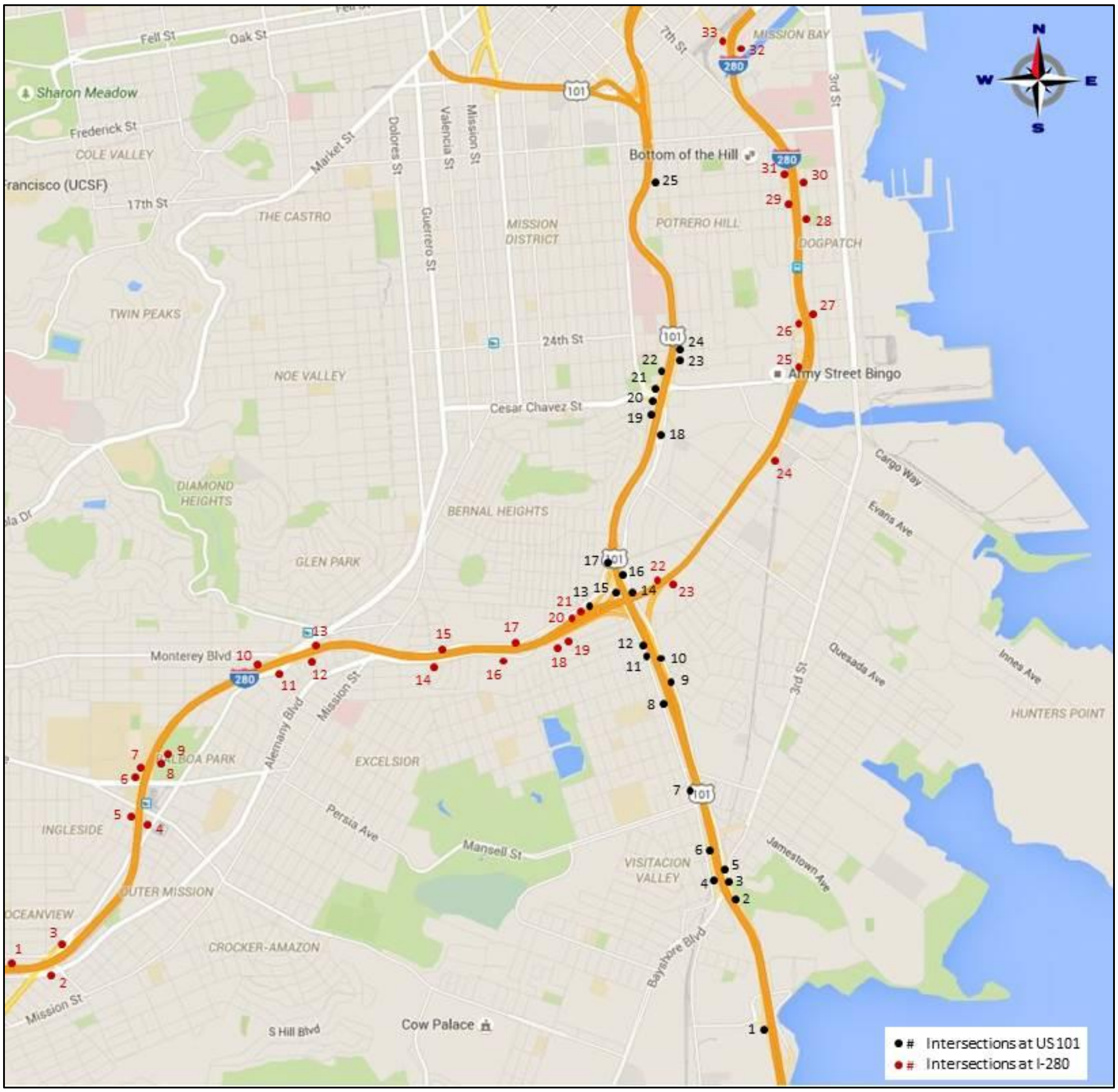


Table 23: Local On- and Off-Ramp Intersections with US 101 in San Francisco

#	Post Mile	Intersection	Type of Intersection	Peak Hour Ramp Volumes	
				AM	PM
1	0.1	SB off-ramp to Tunnel Avenue	Stop Sign and Free Right Turn	223	168
2	0.379	NB off-ramp to Third Street	Signalized	310	274
3	0.561	NB off-ramp to Bayshore Blvd	Uncontrolled	225	358
4	0.596	SB on-ramp from Third St	Signalized and Stop Sign		
5	0.692	NB on-ramp from Bayshore Blvd	Uncontrolled	1,442	1,142
6	0.844	SB off-ramp to Bayshore Boulevard	Signalized	911	1,133
7	1.049	SB off-ramp to San Bruno Avenue	Stop Sign	386	738
8	1.423	SB on-ramp from I-280	Uncontrolled	3,150	3,136
9	1.443	NB off-ramp to I-280	Uncontrolled	4,254	5,184
10	1.627	NB off-ramp to Bayshore Blvd	Signalized	156	300
11	1.636	SB on-ramp from San Bruno Ave	Signalized	355	218
12	1.763	SB off-ramp to San Bruno Avenue	Signalized	299	561
13	1.938	SB off-ramp to Alemany Boulevard	Signalized		
14	1.991	NB off-ramp to Alemany Boulevard	Signalized	294	708
15	2.004	SB on-ramp from Alemany Blvd	Signalized	357	379
16	2.161	NB on-ramp from Alemany Blvd	Signalized	878	223
17	2.178	SB off-ramp to I-280	Uncontrolled	2,357	3,642

Table 24: Local On- and Off-Ramp Intersections with I-280

#	Post Mile	Intersection	Type of Intersection	Peak Hour Ramp Volumes	
				AM	PM
18	R3.975	NB off-ramp to SB US 101	Uncontrolled	1,112	832
19	R4.046	NB off-ramp to NB US 101	Uncontrolled	3,368	1,396
20	R4.051L	SB on-ramp from SB US 101	Uncontrolled	664	1,219
21	R4.061L	SB on-ramp from NB US 101	Uncontrolled	2,201	3,451
22	R4.374	SB off-ramp to SB US 101	Uncontrolled	2,038	2,344
23	R4.520L	NB on-ramp from NB I-280	Uncontrolled	3,708	3,965
24	R5.182R	NB off-ramp to Cesar Chavez Street	Signalized	1,001	713
25	R5.704	SB on-ramp from Pennsylvania Avenue	Uncontrolled and Free Rt Turn	648	1,203
26	R6.046	SB off-ramp to Pennsylvania Avenue	Stop Sign and Free Right Turn	380	515
27	R6.061	NB on-ramp from Indiana Street	Uncontrolled		
28	R6.518	NB off-ramp to Mariposa Street	Signalized	1,661	686
29	R6.524	SB on-ramp from Mariposa Street	Stop Sign	531	1,177
30	R6.641	NB on-ramp from 18th Street	Uncontrolled and Free Rt Turn	144	129
31	R6.690	SB off-ramp to 18th St/Pennsylvania Av	Stop Sign and Free Right Turn	288	305
	R6.900	NB off-ramp to 6th Street	Signalized	2,181	1,950
	R6.850	SB on-ramp from 6th Street	Signalized	1,901	2,572
32	T7.056	NB off-ramp to King Street/5th Street	Signalized	1,519	1,602
33	T7.166	SB on-ramp from King Street/5th Street	Signalized	985	1,330

Various Sources

The locations of local street and freeway interfaces within the San Mateo portion of the study area are shown in Figure 7 and listed in Table 25. Within this area, the US 101 corridor has 5 on-ramps and 6 off-ramps in the northbound direction, as well as 5 on-ramps and 6 off-ramps in the southbound direction. Table 25 lists the local on and off ramps, peak hour ramp volumes (where data was available), as well as the intersection control type.

Figure 7: Freeway Interfaces with Local Streets in San Mateo County

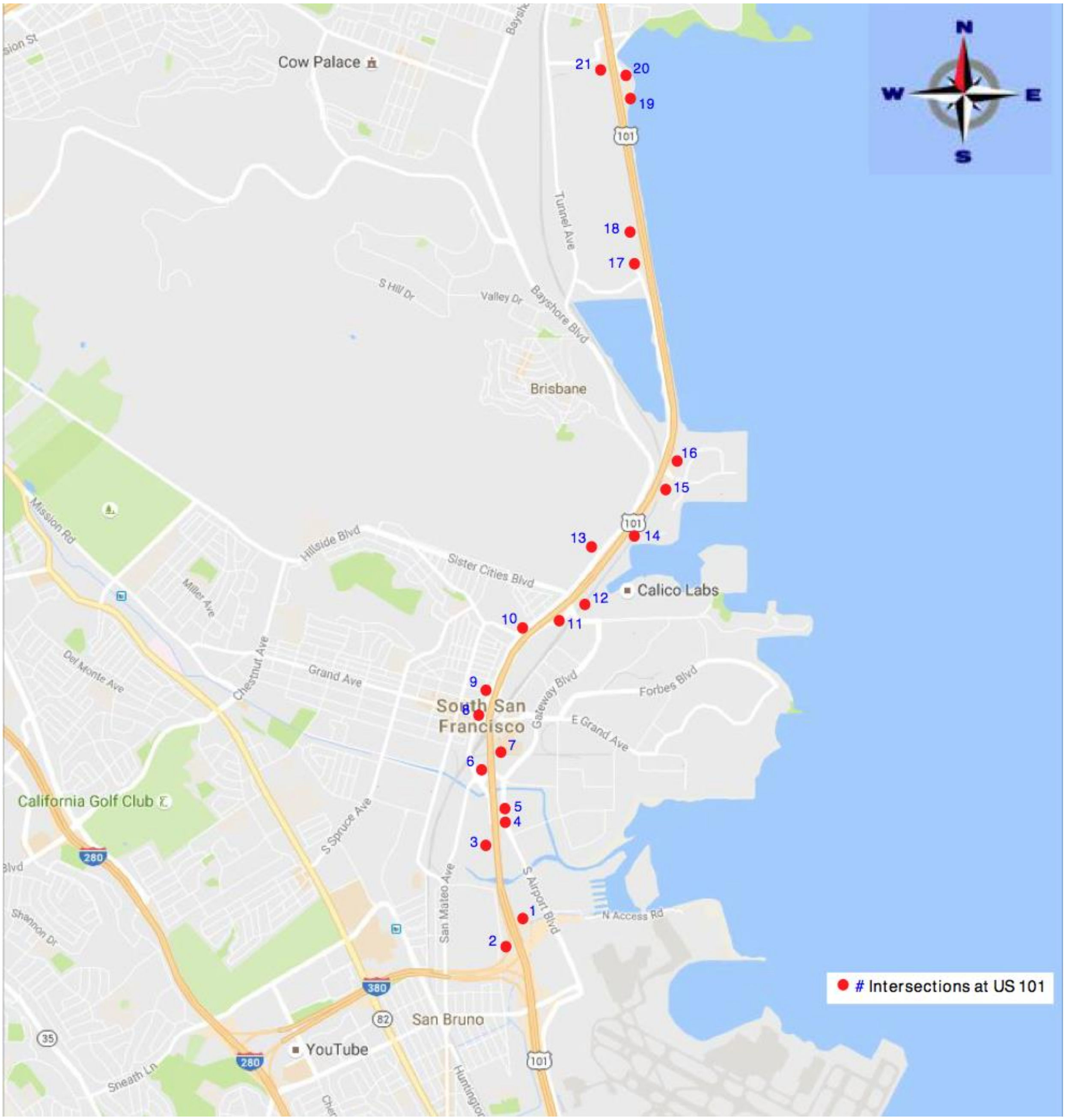


Table 25: Local On- and Off-Ramp Intersections with US 101 in San Mateo

#	Post Mile	Intersection	Type of Intersection	Peak Hour Ramp Volumes	
				AM	PM
1	020.979	NB on-ramp from I-380	Uncontrolled	1,513	2,379
2	020.980	SB off-ramp to WB I-380	Uncontrolled	1,312	641
3	021.386	SB on-ramp from Produce Ave/Airport Blvd	Uncontrolled	1,088	1,528
4	021.398	NB off-ramp to S Airport Blvd	Signalized	1,312	641
5	021.496	NB on-ramp from S Airport Blvd	Signalized	327	495
6	021.691	SB off-ramp to Produce Ave/Airport Blvd	Stop Sign and Free Right Turn	535	717
7	021.874	NB off-ramp to Industrial Way	Uncontrolled		
8	022.144	NB on-ramp from Grand Ave/Airport Blvd	Signalized	678	855
9	022.211	SB off-ramp to Airport Blvd/Miller Ave	Signalized	703	599
10	022.564	SB on-ramp from Oyster Point Blvd	Signalized	660	1,208
11	022.605	NB off-ramp to Oyster Point Blvd	Signalized	794	506
12	022.922	NB on-ramp from Oyster Point Blvd	Signalized	844	1,230
13	023.000	SB off-ramp to Oyster Point Blvd	Signalized		
14	023.261	SB off-ramp to Old Bayshore	Signalized	241	463
15	023.264	NB off-ramp to Old Bayshore	Uncontrolled	649	902
16	023.445	NB off-ramp to Marina Blvd	Stop controlled		
17	023.907	NB on-ramp from Sierra Point Pkwy	Uncontrolled		
18	024.892	SB on-ramp from Sierra Point Pkwy/Marina Blvd	Stop controlled	103	394
19	025.046	SB off-ramp to Marina Blvd/Sierra Point Pkwy	Stop controlled	292	199
20	025.704	NB off-ramp to Harney Way	Uncontrolled	223	447
21	025.844	NB on-ramp from Harney Way	Uncontrolled	342	183
22	025.914	SB on-ramp from Harney Way	Stop controlled		

Various Sources

The ramp volumes are useful for identifying heavily travelled intersections that may require further analysis in subsequent stages of the project development process. On US 101, ramps with volumes that are considered significant (over 700 vehicles per hour) include the following:

- South Airport Boulevard northbound off ramp in the AM peak hour
- Grand Avenue northbound on ramp in the PM peak hour
- Oyster Point Boulevard northbound off ramp (AM) and southbound on ramp (PM), which share the same intersection; and the northbound on ramp (PM), whose intersection also serves the majority of other two ramps' traffic
- Bayshore Boulevard (San Mateo County) northbound off ramp in the PM peak hour, which ends in a merge with northbound Bayshore Boulevard that is crossed by a bicycle lane
- Bayshore Boulevard (San Francisco County) northbound on ramp (AM) and southbound off ramp (PM), which share the same intersection with light rail
- San Bruno Avenue southbound off ramp in the PM peak hour
- Alemany Boulevard northbound off ramp in the PM peak hour

On I-280, high-volume ramps include the following locations:

- Cesar Chavez Street northbound off ramp (AM) and Pennsylvania Avenue southbound on ramp (PM), which share the same intersection
- Mariposa Street northbound off ramp (AM) and southbound on ramp (PM)
- 6th Street northbound off ramp (AM) and southbound on ramp (PM), which share the 6th and Brannan intersection
- King Street northbound off ramp (PM) and southbound on ramp (AM), which share the 5th and King intersection

Level of service data was available for several of the ramp intersections at the northern end of I-280 from the Pier 70 TIA (see Table 18). The following intersections were below LOS D for either the AM or PM peak hour, with the worst LOS listed as follows:

- Mariposa Avenue northbound off ramp intersection is at LOS E in the AM peak hour
- Mariposa Avenue southbound on ramp intersection is at LOS F in the PM peak hour
- 6th and Brannan intersection is at LOS F in the PM peak hour
- 5th and King intersection is at LOS E in the AM peak hour

BICYCLE AND PEDESTRIAN CONSIDERATIONS

A description of the bicycle and pedestrian networks that connect to and parallel the US 101 and I-280 corridors is provided below, along with some safety considerations that should be investigated further during later phases of the project development process.

Bicycle Network

A number of the Official San Francisco Bike Routes are designated within the San Francisco portion of the study area. The facilities are a mix of on-street dedicated bike lanes and lanes shared with vehicle traffic. These designated bike routes in this area are detailed in Tables 26 and 27, and illustrated in Figure 8. While numerous bicycle routes exist in the area, bicycle travel is complicated by the natural barriers of the topography and infrastructure barriers of US 101 and I-280. The neighborhoods of Potrero Hill and Bernal Heights, characterized by particularly steep terrain, do not have any designated routes.

The City/County Association of Governments of San Mateo County (C/CAG) adopted the San Mateo County Comprehensive Bicycle and Pedestrian Plan in 2011. Figure 9 shows the existing and proposed bikeway network as well as existing and proposed bicycle and pedestrian overcrossings and proposed arterial crossing improvements. The following roadways in the study area are designated as key corridors: Bayshore Boulevard, Airport Boulevard, Gateway Boulevard and US 101 between Sierra Point Parkway and the San Francisco county line.

The San Francisco Bay Trail is a key feature for providing longer distance bicycle travel within the study area. The trail is a planned 500-mile walking and cycling path, separated from vehicle traffic, which runs through all nine Bay Area counties and 47 cities. 345 miles of the path have already been completed, including some portions of path running along the shoreline of the San Francisco Bay within the study area. The trail does not currently have a connection between India Basin and South Basin, but current plans propose to continue the trail around the shoreline of Hunter's Point. In San Mateo County, the trail has been constructed from Belle Air Road just north of I-380 to the intersection of Sierra Point Parkway and Marina Boulevard. The trail follows the shoreline perimeter of the office park developments at Oyster Point and Sierra Point. There is currently no connection between Sierra Point Parkway and the San Francisco County line.

Table 26: East-West Bicycle Routes (San Francisco)

Route	Local Streets
30	Folsom Street
36	Townsend Street, Division Street, 14th Street
40	16th Street, 17th Street
44	22nd Street
60	Cesar Chavez Street
66	Crescent Avenue, Richland Avenue
68	Evans Avenue
70	Silver Avenue, Palou Avenue
84	Ocean Avenue
90	Ocean Avenue
170	Oakdale Avenue
990	City College Pedestrian Bridge

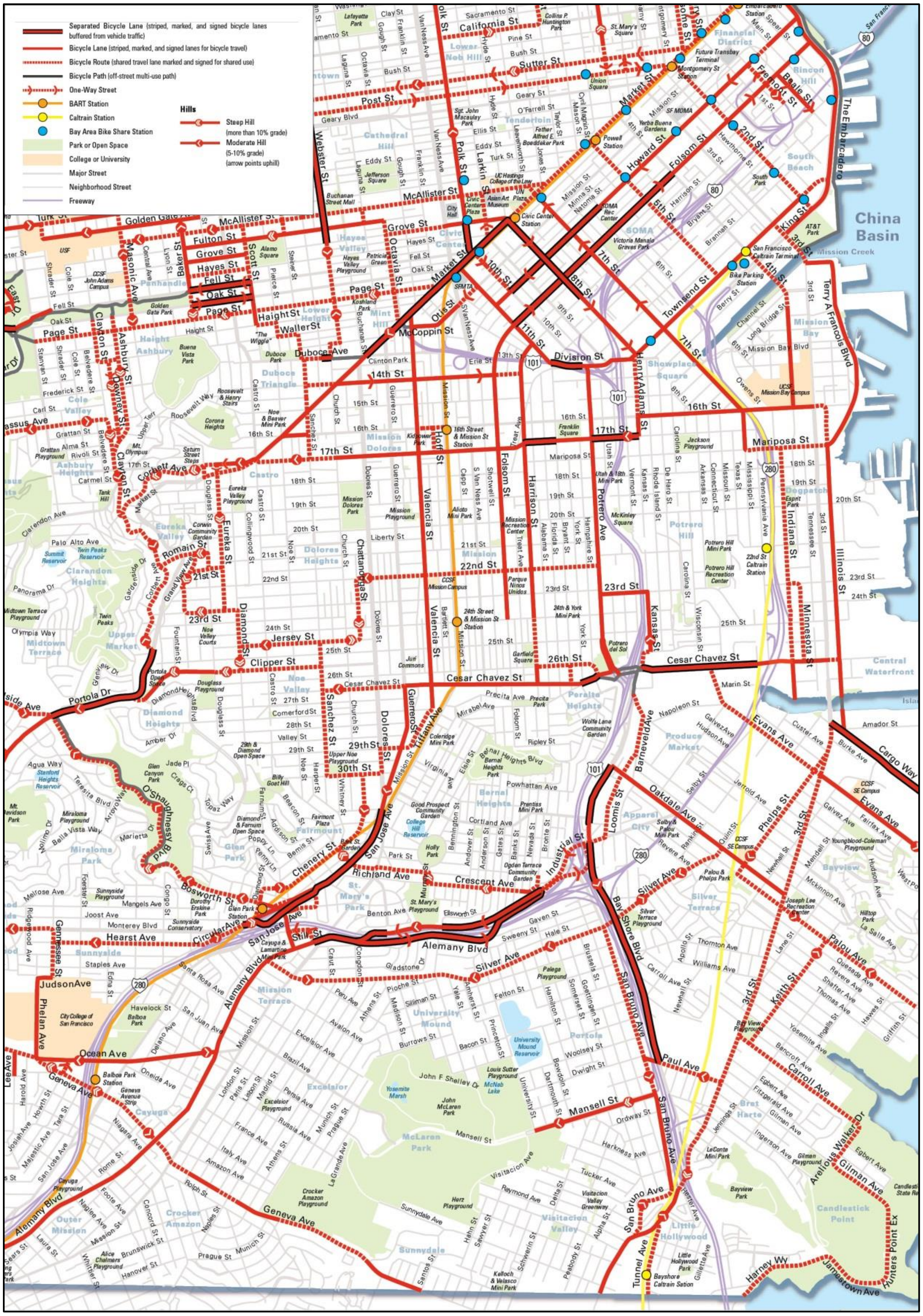
Sources: "Bicycle Route Network" San Francisco Bicycle Plan. San Francisco Municipal Transportation Agency. 2009.
San Francisco Bike Map & Walking Guide 14th Edition. Rufus Graphics/Rufus Guides. 2014

Table 27: North-South Bicycle Routes (San Francisco)

Route	Local Streets
5	Terry A Francis Boulevard, Illinois Street, Cargo Way
7	Indiana Street, Third Street, Phelps Street, Palou Avenue
11	2nd Street
19	5th Street
23	8th Street, Grove Street
25	11th Street
33	Harrison Street
45	Valencia Street, San Jose Avenue, Alemany Boulevard
123	Henry Adams Street
525	Kansas Street
705	Mansell Street
805	Carroll Ave, Arelious Walker Drive, Hunters Point Expressway, Harney Way, Alanna Way
905	Tunnel Avenue
925	Blanken Avenue

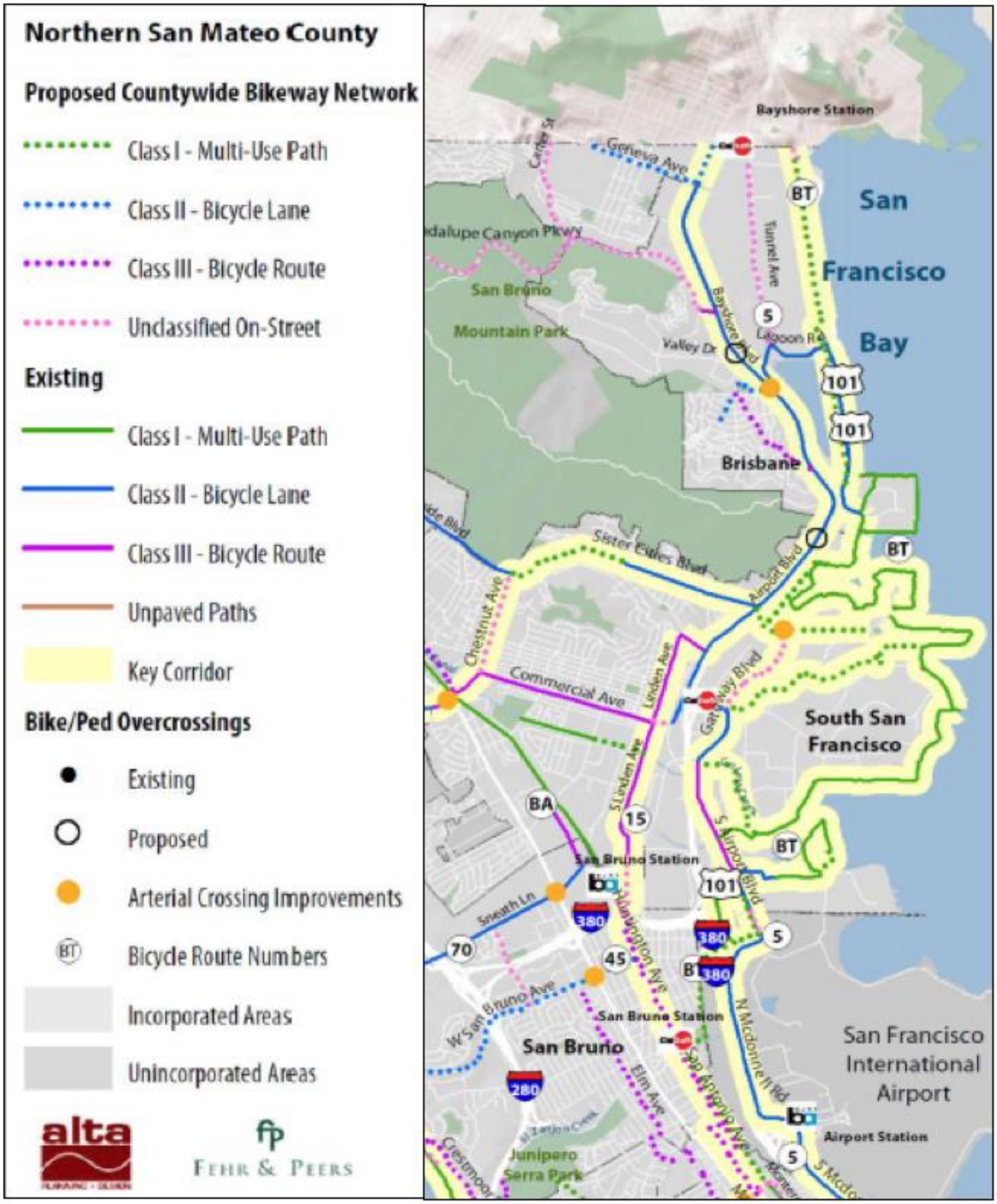
Sources: "Bicycle Route Network" San Francisco Bicycle Plan. San Francisco Municipal Transportation Agency. 2009.
San Francisco Bike Map & Walking Guide 14th Edition. Rufus Graphics/Rufus Guides. 2014

Figure 8: Study Area Bicycle Facilities (San Francisco)



Sources: "Bicycle Route Network" San Francisco Bicycle Plan. San Francisco Municipal Transportation Agency. 2009.
San Francisco Bike Map & Walking Guide 14th Edition. Rufus Graphics/Rufus Guides. 2014

Figure 9: San Mateo Countywide Bikeway Network – North County



Source: San Mateo County Comprehensive Bicycle and Pedestrian Plan. C/CAG 2011.

Pedestrian Network (San Francisco)

The San Francisco portion of the study area has two major pedestrian network typologies: residential neighborhoods and former industrial sites with emerging residential uses. The residential neighborhoods of the area include Potrero Hill, the Mission District, and Bernal Heights. These areas are comprised of pedestrian-friendly, narrow, slower speed streets encouraging pedestrian access through streetscape elements such as sidewalks, street trees, open spaces, and marked pedestrian crossings. The former industrial sites near the waterfront, including some of the South of Market district, the Design District, Mission Bay, Dogpatch, and the Central Waterfront, are characterized by wider streets with pockets of streets lacking sidewalks. In recently constructed residential projects in these former industrial sites, efforts have been made to enhance the sidewalks and refurbish the streetscape.

Variations in the pedestrian conditions occur where US 101 and I-280 interact with the local street network. Both freeways transition from above grade to below grade structures, creating barriers for pedestrian access. Pedestrian interaction with the freeway occurs at pedestrian-only overcrossings, locations where the local street network continues above or below the freeway, and where the freeway on- and off-ramps connect to the local street network. Tables 28 and 29 catalog the pedestrian crossings of US 101 and I-280 within the San Francisco portion of the study area. There are no pedestrian overcrossings for US 101 in the San Mateo portion of the study area, though one has been proposed at about the midpoint between the Oyster Point and Sierra Point interchanges. At this location, the Bay Trail is east of the Caltrain tracks and US 101, while San Bruno Mountain State Park is just west of US 101. A pedestrian overcrossing at this location would provide a convenient connection between the two recreational facilities.

Table 28: US 101 Pedestrian Crossings (San Francisco)

	Location	Pedestrian Conditions
Pedestrian Bridges	San Bruno Ave / 18th Street to Utah Street / 19th Street	Both sides of the bridge touch down to areas with good pedestrian facilities. There are no stairs to access the bridge which allows for bikes or pedestrians with limited mobility; however, the eastern side of US 101 in this area is the neighborhood of Potrero Hill, which is characterized by steep terrain.
Pedestrian Bridges	Vermont Street to Kansas Street (between 22nd Street and 23rd Street)	Ramp connection to the local street network allows for bike or ADA accessible crossing. The connection is between areas with good pedestrian facilities. The eastern side of the bridge is near a dead-end at Kansas Street, and there is no signage to indicate an available crossing.
Pedestrian Bridges	Vermont Street to Kansas Street (between 24th Street and 25th Street)	Both sides of the bridge drop down to streets with good pedestrian facilities, but the overpass has been closed since the 1990s with signage directing pedestrians to cross US 101 at 23rd Street.
Pedestrian Bridges	Holladay Avenue between Costa Street and Faith Street to Bayshore Boulevard / Faith Street	Faith Street on the eastern side of US 101 is a dead-end street, and there is no existing wayfinding to indicate that pedestrian access across US 101 is available. The bridge on the western side of US 101 touches down on Holladay Avenue, with no markings for a pedestrian crossing between the bridge landing and the sidewalk; however, the street is narrow and only serves local traffic so potential for conflict is low.
Loc	23rd Street	Pedestrian facilities are provided on both the northern and southern side of the street. On both sides of US 101, there are 4-way, stop controlled

		pedestrian crossings.
	Cesar Chavez Street	Pedestrians must navigate a maze of ramps connecting to Cesar Chavez, Potrero Avenue, Jerrold Avenue, Bayshore Boulevard, Vermont Street. There are no defined pedestrian crossings to facilitate walking east/west on Cesar Chavez.
	Cortland Avenue	Cortland Avenue crosses under US 101 with bus stops for Muni route 24 near the intersection of Cortland Avenue and Bayshore Avenue. Although the crossing under US 101 is prone to poor lighting conditions and limited visibility from other streets, there are sidewalk facilities on both the northern and southern side of the street.
	Alemany Boulevard	Signalized intersections with marked pedestrian crossings and bus stops for several lines on both the west and east side of US 101. While sidewalks facilitate crossings, pedestrians must navigate under a series of overpasses, making wayfinding difficult.
	Silver Avenue	Crosses over US 101 and under I-280. There are pedestrian facilities on both sides of the crossing, but lower lighting conditions exist under I-280. Adjacent intersections are marked, but have long crossings without pedestrian medians or islands.
	Bacon Street	Good crossing markings on adjacent signalized intersections and sidewalks on both the north and the south side of the street approaching the freeway underpass; however, underpass is subject to lower lighting conditions. Muni bus stations near the intersection.
	Paul Avenue	Adjacent intersections have well marked crossings and are signalized. Paul Avenue crosses under US 101 and is subject to typical tunnel conditions.
	Alanna Way	Pedestrian facilities end approaching this US 101 underpass from the west side of Alanna Way.

Table 29: I-280 Pedestrian Crossings

	Location	Pedestrian Conditions
Pedestrian Bridges	Havelock Street to Balboa Park	Access available from the parking lot of San Francisco City College bungalows. Havelock Street is narrow street but does not have signage for pedestrians crossing to the bridge. On the eastern side of I-280, there is potential for the gates to be closed to the pedestrian crossing. There is no signage indicating the hours during which the bridge is open.
	Circular Avenue / Monterey Boulevard to San Jose Avenue (between Cotter Street and Theresa Street)	Pedestrian bridge provides access to both the western and eastern sides of San Jose Avenue. All three entrances/exits from the pedestrian bridge drop down to streets with wide sidewalks. The intersection near Circular Avenue has a signalized pedestrian crossing.
	St. Mary's Park to Cambridge Street / Gladstone Street	The intersection at Cambridge Street / Gladstone Street has a new signalized pedestrian crossing with bulbs outs on the corners on the intersection.
Loca	Ocean Avenue	Signalized crossing at the on-ramp with pedestrian facilities on north and south side of the street.

	Paulding Street	Stop controlled intersections on both sides of the overpass. Good conditions on the western side of I-280 with pedestrian medians, bulb outs, and newly painted crossings on the western side of I-280. On the eastern side no painted crosswalks. There is limited lighting on the overpass itself.
	Baden Ave	Adjacent intersections are stop controlled with newly painted crosswalks. Sidewalks exist on both sides of the overpass.
	Lyell Street	Crosses under I-280 with limited lighting in the underpass. Sidewalks on both sides of the underpass. This is also bike route 45.
	Mission Street	Overpass of I-280 with wide sidewalks.
	Justin Drive	Overpass of I-280 with sidewalk only on the west side. There is a one-way bike route on Justin Drive connecting bike route 25 to bike route 45.
	Alemany Boulevard - Westbound	Overpass of I-280 with a one way bike route crossing from the west side of I-280 to the east side of I-280, but there is no pedestrian crossing/sidewalk.
	Alemany Boulevard - Eastbound	Overpass of I-280 with one-way bike lane from the east side of I-280 to the west side of I-280 buffering pedestrians sidewalk from traffic. While it is possible to cross 280 at this point, it is undesirable because of additional length between connections with local streets; this crossing parallels the I-280 on ramps from Alemany Boulevard.
	Streets north of the US 101 Interchange	On the eastern section of I-280, after the interchange with US 101, most local streets create connections under I-280. However, these areas are largely industrial and often do not have pedestrian facilities.
	Fourth Street	I-280 terminates, becoming King Street at this wide intersection. Pedestrians must navigate crossing six vehicular lanes and two Muni light rail tracks. Although the crossings are wide, all four legs of the intersection are signalized, well-marked, and provide pedestrian islands for stopping mid-crossing safely.

As shown previously in Tables 28 and Table 29, for local on- and off-ramp intersections for US-101 and I-280 respectively, there are numerous on- and off-ramp intersections with the local street network, creating potential points of conflict between pedestrians and vehicular traffic. In general, the uncontrolled intersections pose the most undesirable and potentially hazardous conditions for pedestrians as pedestrians may unpredictably cross vehicular ramp traffic, and there are no pedestrian markings for crossing.

The intersection at Sixth Street and Brannan Street is the location of the northernmost on-/off-ramp for I-280. Vehicles traveling to and from the ramps are controlled by a traffic signal, and there is no marked pedestrian crossing along the east side of Brannan Street. These features limit potential pedestrian conflict with traffic entering and exiting I-280. Pedestrians are directed to cross at the other three legs of the intersection by well painted and signalized crossings.

Safety Considerations for Bikes & Pedestrians

San Francisco has adopted a Vision Zero goal of no traffic deaths by 2024. Data from the Vision Zero program is the most comprehensive source available for bike and ped safety data for intersections within San Francisco in this project's study area. It is recommended that more detailed analyses of bicycle and pedestrian safety conflicts be conducted during subsequent project development phases for intersections that may be affected by a managed lane alternative. As part of the Vision Zero program, the city has identified Vision Zero Priority Projects. These projects include three in the study area on streets that could be affected by managed lane alternatives, as listed in Table 30.

Table 30: Vision Zero Priority Projects in Study Area (San Francisco)

Project Description and Location	Potential Managed Lane Interaction
6th Street Complete Street Project	Possible route for outbound buses to reach the 6th and Brannan on-ramp to I-280
Potrero Ave Complete Street Project, Division Street to Cesar Chavez Street	Parallel major arterial that could be affected by spillover traffic
San Jose Ave Road Diet and Cycletrack	Parallel major arterial that could be affected by spillover traffic

Source: Vision Zero Priority Projects. http://visionzerosf.org/wp-content/uploads/2016/06/Vision-Zero-Priority-Projects-2016-2017.pdf

The Vision Zero website includes a map tool that shows streets included in the "High Injury Network" plus locations of "Pedestrian High Injury Intersections" and "Cyclist High Injury Intersections". Streets and locations within the study area are listed in Tables 31, 32 and 33.

Table 31: San Francisco Vision Zero "High Injury Network" Locations

Location	Potential Managed Lane Interaction
3rd and 4th Streets from King St to Market St	Possible routes for inbound & outbound buses to/from I-280
King St between 5th and 3rd Streets	Possible route for inbound buses from King Street I-280 off-ramp
6th St between Market and I-280 ramps	Possible route for outbound buses to 6th Street I-280 on-ramp
San Jose Ave between Rousseau and 25th St	Parallel major arterial that could be affected by spillover traffic
Ocean Ave btw San Jose and Geneva Ave	Parallel major arterial that could be affected by spillover traffic
Geneva Ave btw Alemany Blvd and Co. Line	Parallel major arterial that could be affected by spillover traffic
Alemany Blvd btw Bayshore and San Jose Ave	Parallel major arterial that could be affected by spillover traffic
Potrero Avenue btw Cesar Chavez and 7th St	Parallel major arterial that could be affected by spillover traffic
3rd Street btw US 101 and Evans Ave	Parallel major arterial that could be affected by spillover traffic
Bayshore Blvd btw 3rd and Cesar Chavez	Parallel major arterial that could be affected by spillover traffic
Junipero Serra Blvd btw Co. line and 19th Ave	Parallel major arterial that could be affected by spillover traffic
Guerrero St btw Cesar Chavez and Market St	Parallel major arterial that could be affected by spillover traffic

Source: Vision Zero High Injury Network Map.
http://sfgov.maps.arcgis.com/apps/OnePane/basicviewer/index.html?appid=335c508503374f5d94c95cb2a1f3f4f4

Table 32: San Francisco Vision Zero "Pedestrian High Injury Intersections"

Intersection	Potential Managed Lane Interaction
Alemany Boulevard and San Juan Avenue	Parallel major arterial that could be affected by spillover traffic
Alemany Boulevard and Niagara Avenue	Parallel major arterial that could be affected by spillover traffic
Alemany Boulevard and Foote Avenue	Parallel major arterial that could be affected by spillover traffic
Bayshore Boulevard and Industrial Street	Parallel major arterial that could be affected by spillover traffic
Bayshore Boulevard and Cesar Chavez	Parallel major arterial that could be affected by spillover traffic
Ocean Avenue and Howth Street	Parallel major arterial that could be affected by spillover traffic
King Street and 4th Street	Ramp terminal location and possible route for inbound and outbound buses
3rd Street and Harrison Street	Possible route for inbound buses

Source: Vision Zero High Injury Network Map.
http://sfgov.maps.arcgis.com/apps/OnePane/basicviewer/index.html?appid=335c508503374f5d94c95cb2a1f3f4f4

Table 33: San Francisco Vision Zero "Cyclist High Injury Intersections"

Intersection	Potential Managed Lane Interaction
3rd Street and Marin Street	Parallel major arterial that could be affected by spillover traffic
San Jose Avenue and 30th Street	Parallel major arterial that could be affected by spillover traffic

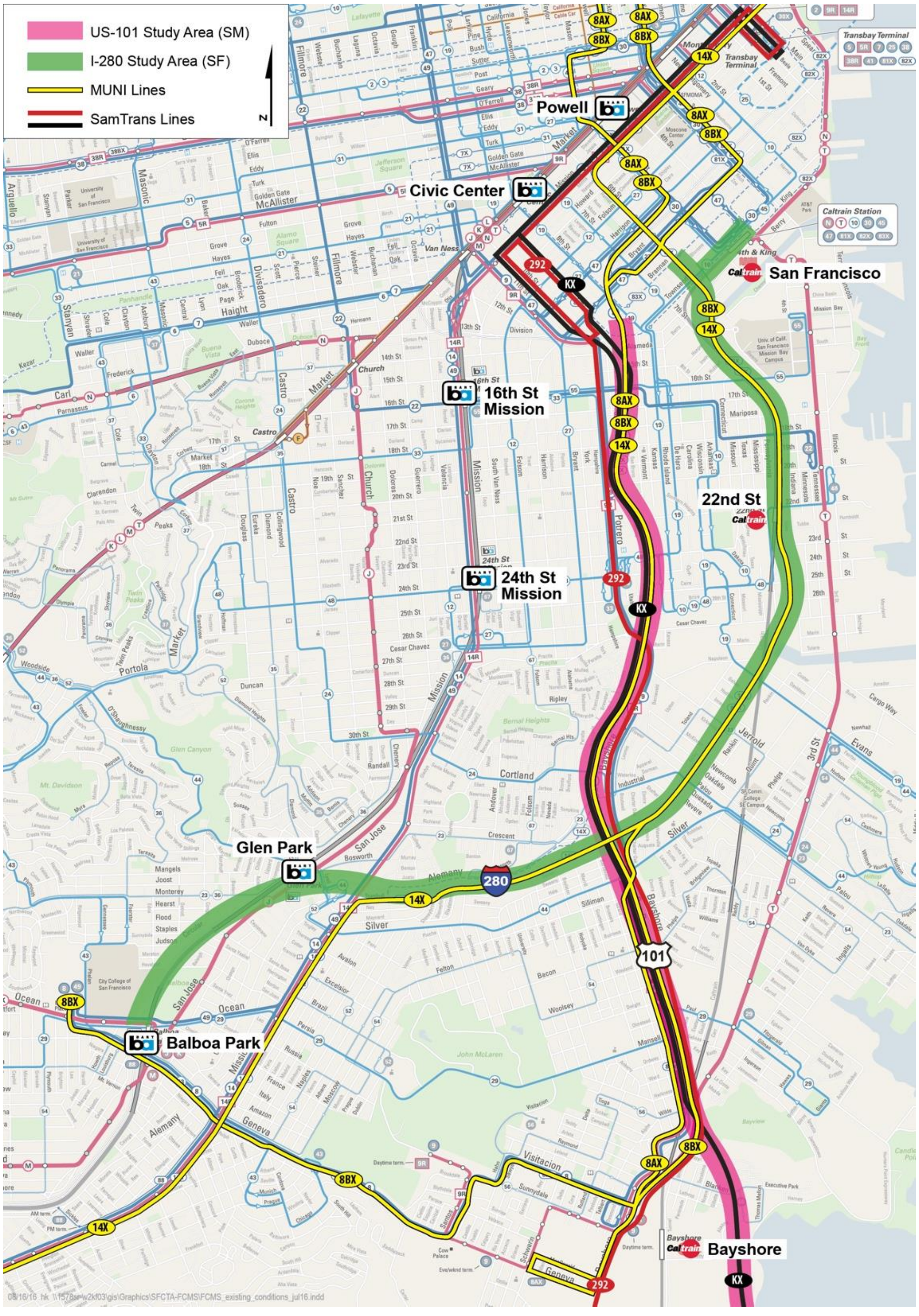
Source: Vision Zero High Injury Network Map.
http://sfgov.maps.arcgis.com/apps/OnePane/basicviewer/index.html?appid=335c508503374f5d94c95cb2a1f3f4f4

In addition, the San Mateo County Comprehensive Bicycle and Pedestrian Plan mentioned above considered bicycle and pedestrian safety issues and included countywide heat maps indicating areas with higher rates of bicycle and pedestrian accidents. This project's study area had low rates of both pedestrian and bicycle accidents. The plan also identified US 101 and Caltrain as major barriers. At barrier crossings, the plan recommends provision of marked crossings at signalized and stop controlled locations on access routes to barrier crossings. At the barrier crossings themselves, the plan recommends paths or detached sidewalks with pedestrian-scale lighting. The plan also identified pedestrian focus areas. These were primarily located in commercial and retail areas, but some were in recreational areas. The location of the proposed pedestrian overcrossing discussed above, which would connect the Bay Trail with San Bruno Mountain Park, was identified as a pedestrian focus area, as was land on both sides of US 101 near the commercial heart of South San Francisco.

TRANSIT NETWORK

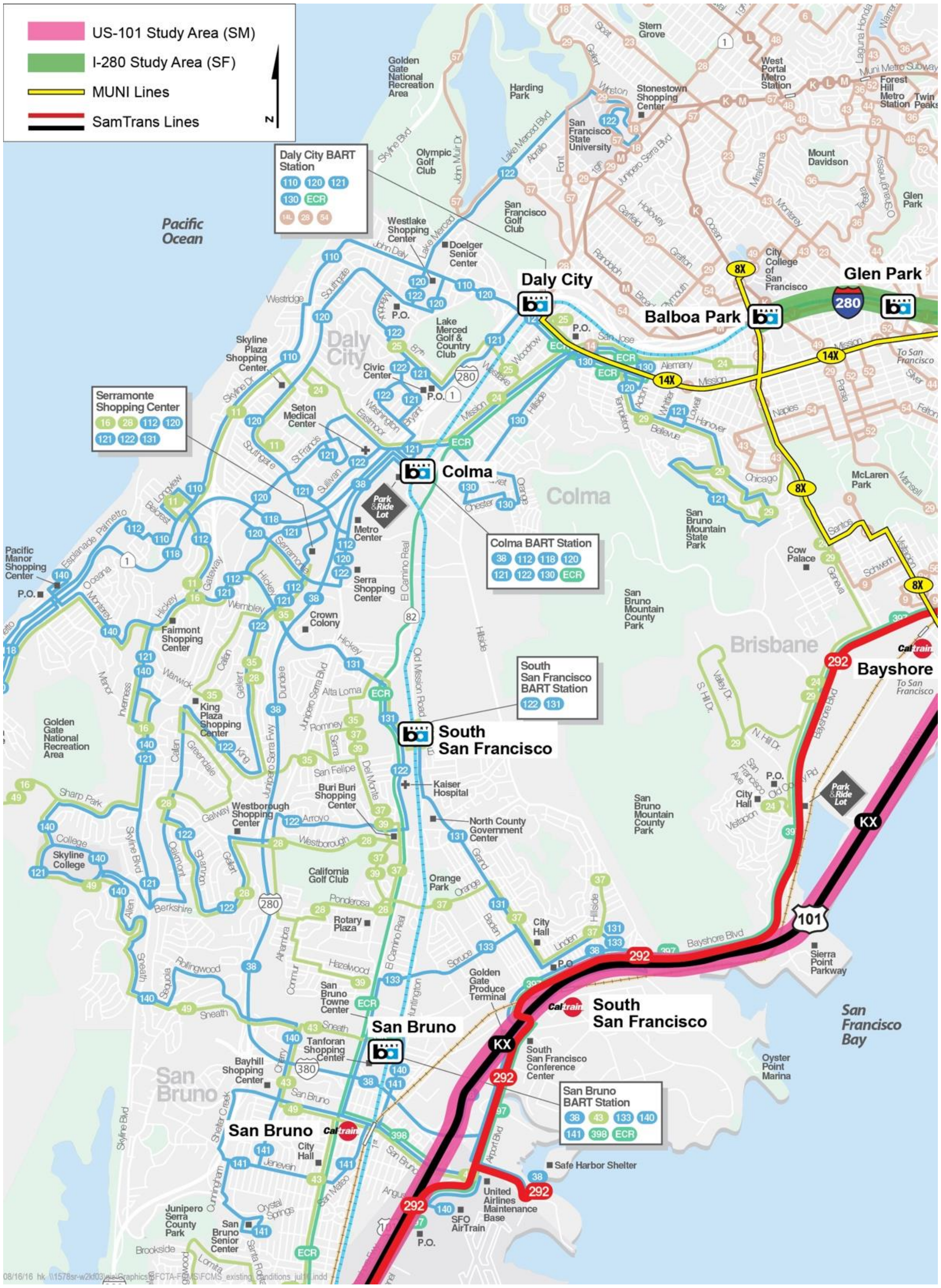
A description of transit services that connect to and parallel the US 101 and I-280 corridors within the study area is provided below. Key local and regional transit services within this area are illustrated in Figures 10 and 11.

Figure 10: Study Area Transit Network (San Francisco)



Source: Muni System Map. San Francisco Municipal Transportation Agency. December 2015.

Figure 11: Study Area Transit Network (San Mateo)



Source: SamTrans System Map. San Mateo County Transit District. January 2016.

Muni

The San Francisco Municipal Railway (Muni) transit system, comprised of buses, historic street cars, light rail, and cable cars, provides local service within the city of San Francisco, and is operated by the San Francisco Municipal Transportation Agency (SFMTA). There are approximately 3,500 transit stops maintained by SFMTA within San Francisco. While most routes terminate within the city boundaries, some service is available into Daly City, terminating at the near the Daly City BART station.

Within the San Francisco study area boundaries, Muni operates bus and light rail service. Table 34 details the service provided by Muni in the study area.

Some of the longest bus routes in this portion of the study area include lines 8, 8AX, 9, 9R, 14, 14R, 29, and 49. Bus lines 8, 8AX, 8BX, 9, and 9R run from downtown San Francisco to Visitacion Valley paralleling US 101 and covering the length of this area. Lines 14, 14R and 49 operate on surface streets parallel to the BART line and also cover the length of this area. Of these lines, the 8AX, 8BX, and 14X use the freeway for a portion of their route. Line 29 begins in the Bayview District and crosses both US 101 and I-280 in the southern portion of this area, and continues northeast to serve the Sunset and Richmond districts, before terminating in the Presidio. Other bus services listed in Table 34 provide key connections to downtown San Francisco.

The Muni Metro light rail service within this portion of the study area operates both street level and underground service, with underground service operating along Market Street. The light rail lines J and M have the same terminal points, at Embarcadero Station and Balboa Park Station, but the lines branch out between Market/Church Street and Balboa Park serving different parts of the city between terminals. The KT-line, which also has terminal station at Balboa Park Station begins with the K Line heading towards the West Portal Muni Metro Station. The service then changes to the KT-Line which continues towards the Embarcadero Muni Metro/BART Station. Beyond the Embarcadero Muni Metro/BART Station, the service changes to T-Line going towards King Street and serves the San Francisco Caltrain station at 4th/King St. The T-Line goes along 3Rd St and the end of line is at the Bayshore Boulevard / Sunnydale Avenue stop.

Table 34: Study Area Muni Transit Service (San Francisco)

Vehicle Type	Route	Weekday Boardings	Terminal A	Terminal B	Headway (Minutes)	Hours of Operation
Bus	8 Bayshore	22,858	Fisherman's Wharf	City College via Visitacion Valley	7 – 15	5:30 AM– 12:30 AM
	8AX Bayshore A Express	4,760	Chinatown	Visitacion Valley	6 – 7	Weekday Peak Hours
	8BX Bayshore B Express	5,719	Fisherman's Wharf	City College	7	Weekday Peak Hours
	9 San Bruno	12,392	Ferry Plaza	Visitacion Valley & Sunnydale	12 – 20	6:00 AM – 12:10 AM
	9R San Bruno Rapid	7,174	Ferry Plaza	Sunnydale	8	6:20 AM – 5:50 PM
	14 Mission	27,244	Ferry Plaza	Daly City	8 – 15	24 Hrs.
	14R Mission Rapid	17,494	Mission & Main	Daly City	8 – 12	6:50 AM – 6:00 PM
	14X Mission Express	2,717	Ferry Plaza	Daly City	6 – 8	Weekday Peak Hours

Vehicle Type	Route	Weekday Boardings	Terminal A	Terminal B	Headway (Minutes)	Hours of Operation
	19 Polk	8,235	Fisherman's Wharf	Hunter's Point	15 – 30	5:20 AM – 12:40 AM
	23 Monterey	4,289	Bayview District	SF Zoo	20 – 30	5:40 AM – 11:30 PM
	24 Divisadero	11,478	Pacific Heights	Bayview District	9 – 10	24 Hrs.
	29 Sunset	19,749	The Presidio	Bayview District	9 – 30	5:50 AM – 12:10 AM
	44 O'Shaughnessy	16,163	Richmond District	Hunters Point	9 – 20	5:50 AM – 12:30 AM
	56 Rutland	467	Executive Park	Visitacion Valley	30	7:00 AM – 9:00 PM
	88 BART Shuttle	450	Balboa Park Station	Daly City	20	Weekday Peak Hours
Light Rail	J-Church	16,315	Embarcadero Station	Balboa Park Station	9 – 20	5:00 AM – 12:10 AM
Light Rail	M-Ocean View	28,652	Embarcadero Station	Balboa Park Station	9 – 20	4:50 AM – 12:10 AM
Light Rail	KT-Ingleside /Third Street	35,527	Embarcadero Station (K)	Balboa Park Station (K)	9 – 20	4:40 AM – 12:20 AM
			Visitacion Valley (T)	Embarcadero Station (T)	9 – 20	4:40 AM – 12:20 AM

Source: National Transit Database (NTD), FY 2014; SF Municipal Railway, City and County of San Francisco, 2015
Notes: Hours of operations may be truncated during weekends
Service may be less frequent than noted on weekends

Caltrain

Caltrain provides regional rail service from the study area to points south and serves approximately 62,416 passengers on an average weekday. Service extends to 77.2 miles to Gilroy on weekdays and Tamien Station (one station south of the San Jose Diridon Station) on weekends. Currently, Caltrain runs 46 trains each northbound and southbound on the weekdays, 18 trains in each direction on Saturdays, and 16 trains in each direction on Sundays.

Caltrain service is focused on the morning and evening peak periods, with infrequent service midday. Traditionally, service was oriented toward commute trips inbound to San Francisco in the morning and outbound in the evening. In this respect, there were many more northbound morning trains than southbound. Over the past 20 years, the directionality of commute patterns has become less severe, so that now there is about a 60/40 split between the numbers of passengers traveling in each direction. This is the result of employment growth in the South Bay.

In 2016, Caltrain's annual ridership count found average weekday ridership was 62,000 passengers, with about half traveling in the peak periods. San Francisco is the busiest station, followed by Palo Alto, San Jose, and Mountain View. The average trip length was 23 miles, demonstrating that Caltrain riders are making long trips.[1]

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[1] http://www.caltrain.com/about/MediaRelations/news/Caltrain_Reveals_All-time_High_Annual_Ridership_Numbers.html

Four of Caltrain's 32 stations are located within the study area: San Francisco (4th/King), 22nd Street, Bayshore, and South San Francisco. Caltrain separates its service into local, limited-stop, and Baby-Bullet service. While all trains stop at the San Francisco station at 4th and King, the 22nd Street, Bayshore and South San Francisco stations are occasionally bypassed by limited-stop or Baby Bullet trains.

Service at the San Francisco station is as frequent as every five minutes during the AM rush hour and reduces to 30 to 60-minute headways during late night hours. Transit connections are available to Muni lines 10, 30, 45, 47, 80X, 81X, 82X, 83X, N-Judah, T-Third, 91 Owl, T Owl, and N Owl; and to Amtrak shuttles.

Southbound service at the 22nd Street station is as frequent as every five minutes during the AM rush hour and reduces to 60-minute headways after 10AM. Northbound service runs at approximately 60-minute headways during the AM hours and increases frequency in the PM hours with all trains after 4PM stopping at 22nd Street. Of the four Caltrain stations operating in the study area, this station is the only station located directly in the freeway right-of-way (directly under I-280), and also the only station that is not wheelchair accessible and does not provide bike lockers. A transit connection from 22nd Street is available to the Muni 48 line. Connections are also available within walking distance of the station to Muni lines 10, 22, and T-Third.

Northbound and southbound service at the Bayshore station currently operates with 60-minute headways throughout the day; the station is bypassed by all Baby Bullet service and only sees a handful of limited-stop trains per day. Transit connections at the station are available to the Bayshore/Brisbane Senior Shuttle, Bayshore/Brisbane Commuter Shuttle, and the Crocker Park Shuttle. Connections are available within walking distance to Muni lines 8X, 8AX, 8BX, 9, 56, and T-Third; and to SamTrans line 292.

Southbound service at the South San Francisco station currently operates hourly for most of the day, switching to 20 – 40 minute headways during the PM commute period. Northbound service runs at 20 – 40 minute headways during the AM hours and reduces to hourly headways for the rest of the day. The station is bypassed by all Baby Bullet service and but sees 18 limited-stop trains per day. Transit connections at the station are available to the Oyster Point and Utah-Grand shuttles, Bayshore/Brisbane Commuter Shuttle, and the Crocker Park Shuttle. Connections are available within walking distance to SamTrans lines 38, 131,133 292 and 397.

In October of 2015, Caltrain released its Short Range Transit Plan summarizing their operating and capital investment plan across a 10-year horizon. Through FY2020, Caltrain expects to operate the same 92-train weekday schedule seen today, with only minor schedule modifications. The planned Caltrain rail extension from its current terminus at the San Francisco station at 4th St and King Street will bring service into downtown San Francisco to the new Transbay Transit Center. By 2020, Caltrain plans to electrify the portion of the corridor from the San Francisco station at 4th and King to the Tamien station, which will allow the railroad to support High Speed Rail service as well as increased Caltrain capacity.

SamTrans

San Mateo County Transit District operates SamTrans bus service, which provides service from the San Francisco portion of the study area to San Mateo County, as well as service within San Mateo County. In total, the SamTrans service area encompasses 446-square miles, serving approximately 13,158,700 riders per year. Table 35 details the service provided by SamTrans in the study area. Of the routes listed in the table, the two-digit routes are school services that do not provide the all-day mobility options of typical bus transit routes. The 397 and KX routes are peak period-only commute routes. This leaves nine three digit routes that provide all-day transit service in the study area.

Three SamTrans routes operate in the San Francisco portion of study area: the KX – San Francisco to Redwood City Transit Center, 292 – San Francisco to Hillsdale Mall, and the 397 – San Francisco to Palo Alto Transit Center. All three bus lines also serve San Francisco International Airport.

The KX operates on weekdays with four northbound buses to San Francisco in the AM and four southbound buses to Redwood City in the PM. The terminus bus stop is located at the Transbay Terminal (Folsom Street / Beale Street) and the bus continues on Mission Street before getting on southbound US 101 at 10th Street or off northbound US 101 at 9th Street.

The 292 and the 397 both terminate service at the Transbay Terminal and follow the same route within the study area along Market Street and Bayshore Boulevard. Service for the 292 runs on approximately 30-minute headways throughout the weekday, with some reductions in early morning and late night service during the weekends. The 397 route only runs during early morning AM hours; arriving at its final stop before 6:30 AM. Service includes three northbound and four southbound buses. The schedule remains unchanged for both weekdays and weekends.

Table 35: Study Area SamTrans Transit Service

Route	Terminal A	Terminal B	Weekday Boardings	Headway (Minutes)	Hours of Operation
24	Westmoor High	Old County/San Francisco	102	1 trip per day in each direction (school service)	7:00 AM and 3:00 PM
28	Serramonte Center	South San Francisco High	2,856	2 trips per day inbound in AM, 3 trips per day outbound in PM (school service)	7:00 AM – 8:00 AM and 2:00 PM – 4:00 PM
29	Lipman School	Templeton/ Brunswick	2,147	1 trip per day inbound in AM, 2 trips per day outbound in PM (school service)	7:45 AM – 8:15 AM and 2:00 PM – 4:00 PM
37	Alta Loma School	Hillside/Grove	46	1 trip per day in each direction (school service)	8:00 AM – 8:30 AM and 3:30 PM – 4:00 PM
38	Safe Harbor	-	15	5 trips per day outbound in AM, 6 trips per day inbound in PM	6:30 AM – 7:30 AM and 5:30 PM – 7:30 PM
39	Alta Loma School	Hazelwood/ Kenwood	416	1 trip per day in each direction (school service)	7:00 AM and 3:00 PM
43	San Bruno BART	Mills High	8	1 trip per day (school service)	3:30 PM
49	Terra Nova High	Airport/San Bruno	724	1 trip per day in each direction (school service)	7:00 AM and 3:00 PM
120	Brunswick/ Templeton	Colma BART		10 – 15	5:00 AM – 12:00 AM

Route	Terminal A	Terminal B	Weekday Boardings	Headway (Minutes)	Hours of Operation
121	Lowell/Hanover	Skyline College		30	5:00 AM – 11:30 PM
131	Airport/Linden	Serramonte Center		15 – 30	5:00 AM – 10:30 PM
133	Airport/Linden	San Bruno BART		30	6:00 AM – 7:30 PM
140	SFO AirTrain	Manor/Pueblo		20 – 60	5:30 AM – 11:45 PM
141	San Bruno BART	Shelter Creek		30 – 60	6:15 AM – 7:30 PM
292	San Francisco	Hillsdale Mall		30 – 60	4:00 AM – 2:30 AM
397	San Francisco	Palo Alto Transit Center		3 trips per day inbound in afternoon, 4 trips per day outbound in afternoon	12:30 PM – 5:00 PM and 1:00 PM – 6:30 PM
398	San Bruno BART	Redwood City Transit Center		60	5:00 AM –12:00 AM
ECR	Daly City BART	Palo Alto Transit Center		15 - 20	4:00 AM – 2:30 AM
KX	San Francisco	Redwood City Transit Center		4 trips per day inbound in morning, 4 trips per day outbound in afternoon	5:00 AM – 10:00 AM and 3:30 PM – 8:30 PM

Source: San Mateo County Transit District website. August 2016.
Notes: Hours of operations may be truncated during weekends
Service may be less frequent than noted on weekends

Bay Area Rapid Transit District

Bay Area Rapid Transit (BART) connects the San Francisco Peninsula with Oakland, Berkeley, Fremont, Walnut Creek, Dublin/Pleasanton and other cities in the East Bay. Four of the five BART lines stop at each of the study area stations, providing service between Pittsburg/Baypoint and San Francisco International Airport/Millbrae, Dublin/Pleasanton and Daly City, Daly City and Fremont, and between Richmond and Daly City/Millbrae.

BART operates seven days a week, ending service at midnight each day. Trains are in service beginning at 4:00 AM weekdays, 6:00 AM on Saturdays, and 8:00 AM on Sundays. Typically, trains run at 15-minute headways during the weekdays and 20-minute headways on the weekends. In FY15, BART recorded a total annual ridership of 125,979,369 passengers, up 7.6 percent from FY14.[2]

In the study corridor, BART provides all-day service from the northern Peninsula into San Francisco. Most passengers are traveling to work, but there are also many shopping and tourist trips. Major ridership stations in the south end of the BART service area include Millbrae, Colma, and Daly City. Each of these stations has a large parking structure. Passengers access the southern stations primarily via Caltrain (at Millbrae), local transit, park and ride, and kiss and ride. High ridership stations in San

[2] *"Total Annual Exits FY1973-FY2015(.xls)." San Francisco Bay Area Rapid Transit District. 2016. Web.*

Francisco include Embarcadero, Montgomery, and to a lesser extent Powell and Civic Center. At the major San Francisco stations, the majority of passengers walk to and from the stations, but substantial numbers use local transit and bicycles.

The intra-West Bay market from Millbrae to Embarcadero represents 28% of BART's total weekday ridership. In 2012, there were 10,500 AM peak hour passengers traveling through the segment between 16th Street Mission and Civic Center stations, while 3,100 passengers were traveling in the opposite direction. These figures are forecast to grow to 15,800 and 3,800 passengers, respectively, in 2025. (BART – Embarcadero Montgomery Capacity Implementation Plan PowerPoint for August 21, 2014 Technical Advisory Committee meeting)

BART has three stations within the study area: Glen Park, Balboa Park, and San Bruno. The Embarcadero and Montgomery stations are just north of the study area, and the Millbrae station is just south of the study area. In addition, the 16th Street Mission Station is less than one mile from US 101, along 16th Street, right before the US 101 junction with I-80. Similarly, the 24th Street Mission Station is in the vicinity of the US 101 and Cesar Chavez interchange.

All stations within the study area are ADA accessible and provide bicycle parking. Glen Park and San Bruno stations also provide vehicle parking. All of the BART lines run along the same route and serve the same stops within the study area. Connections from BART to other area and regional transit are available as detailed in Table 36.

Table 36: BART Transit Connections

BART Station	Average Weekday Exits Jan 2016	Connections Available Within .25 Mile	
		Muni	SamTrans
16th Street Mission	13,147	12, 14, 14R, 22, 33, 49, 55	
24th Street Mission	13,116	12, 14, 14R, 27, 48, 49, 67	
Glen Park	7,658	23, 36, 44, 52, J	
Balboa Park	11,260	8, 8BX, 28R, 29, 43, 49, J, K, M	
San Bruno	3,965		38, 43, 133, 140, 141, 398, ECR

Source: "Average Weekday Exits by Station(.xls)." Ridership Reports. San Francisco Bay Area Rapid Transit District. 2016. Web. Muni and SamTrans system maps. 2016. Web.

Relationship of Transit to Managed Lanes Facilities

Longer distance and express transit routes will be more affected by implementation of managed lane facilities in the study area than local routes. While there is no formal definition of a longer route, they could be characterized as traveling at least the distance equivalent to a trip between Visitacion Valley and Downtown San Francisco. Rail transit can be considered a longer-distance or express route. Unlike bus routes, rail transit cannot be relocated. Therefore, the likely effects of a managed lanes strategy on rail routes would be to reduce rail transit ridership as passengers shifted to carpool and bus modes that achieved travel time savings due to the managed lanes. Transit services that could be affected in this way are Caltrain, BART and the T and N Muni light rail routes.

Riders of local transit, on the other hand, would not be likely to change modes, because their trips either do not follow closely to the freeway alignments, or are shorter than the typical spacing of entrances and exits to the managed lanes. However, local routes operating on arterials running parallel to the freeways could be negatively affected by increased spillover traffic using the local streets due to reduced freeway capacity reductions in a lane conversion option.

The longer distance and express bus transit routes that could benefit from use of managed lane facilities on their freeway-running segments include Muni routes 8AX, 8BX, and 14X, plus SamTrans routes KX, 292, and 397. All of these lines (except for SamTrans 292 and 397) currently use the freeway for a portion of their route. The only all-day route on this list is SamTrans 292, which generally operates every 30 minutes. The other routes only operate for part of the day; most of these routes operate in the peak commute periods and sometimes only in the peak direction. These routes provide the best opportunity to improve public transit performance with a managed lane project. If travel time reductions are significant, these routes could be operated more frequently and new routes could be developed to meet increasing ridership demand. For example, SamTrans is currently studying the feasibility of significantly expanding express bus service in the US 101 corridor, to support and take advantage of the planned express lanes on US 101 between the San Mateo/Santa Clara County Line and I-380.

Employee Shuttles on the 101 Corridor

Background

As job growth in the 101 Corridor has outpaced the growth in housing units in recent years, the spatial mismatch between housing and jobs has increased. With limited access and capacity in the public transportation network, both large and small employers have pursued various strategies to address commuting challenges, specifically through the provision of private employee shuttles. Employers within the 101 Corridor provide extensive shuttle services that serve as a transit alternative or transit supportive option on a leg of their employee's journeys. These commuter shuttles are designed to bring employees living in major cities in the San Francisco Bay Area (including but not limited to San Francisco, San Jose, Oakland and other areas of the East and South San Francisco Bay Area) to and from their jobs on the Peninsula. The shuttles are owned and operated under a number of models, including by private charter bus companies in contract with a sole employer, directly by the employer, or by third parties serving multiple employers.

Over the last decade, the ad-hoc network has grown into what is believed to be the largest transportation network of its kind in the United States, with all major Silicon Valley tech employers making use of such services[3]. The shuttles have become an expected offering for employees and even a recruiting tool, allowing employees to find housing throughout the San Francisco Bay Area knowing they will have a dependable commuting solution provided by their employer. In addition to providing free transportation to employees, the shuttles offer additional advantages over private cars in that they can operate in express or car-pool lanes and often offer amenities like Wi-Fi internet. However, the private sector nature of the system makes it difficult to know the exact number of shuttles operating or the exact number of passengers being served. Companies view their shuttle offerings as proprietary, and are reluctant to share basic data such as routes, number of bus trips or ridership.

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[3] *http://articles.latimes.com/2014/mar/30/business/la-fi-google-bus-20140330*

Figure 12: Typical Commuter Shuttle Examples

Double Decker Bus (81 persons)

Standard Bus (up to 56 persons)

While the total capacity of the buses is easy to determine, the occupancy rates and overall mode shares are more difficult. However, the City of Mountain View documents the ridership and occupancy of employee shuttles on a semi-annual basis as part their North Bayshore Area Trip Monitoring program. In March of 2016, Mountain View found that 3,289 people were accessing the North Bayshore Area corporate campuses by employee shuttle per weekday, representing 18.1% of all person trips[4]. This represented a slight decline (~5%) from the same period in 2015 as employees appeared to be shifting toward single occupancy vehicles. In terms of per bus rider occupancy, the overall average shuttle occupancy was found to be 35%.

The type of services provided by employee shuttles break down into two categories: (a) origin to destination and (b) first mile/last mile. Origin to destination shuttles pick up employees either at their home or an established regular pick up location, similar to a public bus, and carry passengers all the way to their final destination, typically either at an office building or corporate campus. First mile / last mile services augment public transportation and serve to bridge the gap between a transit stop, which is typically a Caltrain, ACE, or BART station.

Conflicting Regulatory Pressures

With the increase of traffic in the 101 Corridor on the peninsula, a number of municipalities have enacted transportation demand management plans (TDM) and similar measures in an attempt to slow or cap the number of single occupancy vehicle trips coming into or out of their communities. In addition to traffic mitigation, TDM programs have also taken on a role in environmental policy. Such regulations have become a key negotiating piece in the approval of new, large commercial office developments.

In Mountain View, the North Bayshore Area Precise Plan (NBPP) is a TDM program that aims to reduce daily and peak hour vehicle trips below the capacity of the US 101 freeway. The *NBPP* established a vehicle trip cap for vehicles accessing the *NBPP* area, in compliance with the City of Mountain View's trip reduction targets[5]. This plan was a critical negotiating piece in approving added commercial

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[4] *North Bayshore Area Trip Monitoring Annual Report, June 2016*

[5] *City of Mountain View North Bayshore Precise Plan (December 2014).*
Online: http://www.mountainview.gov/civicax/filebank/blobdload.aspx?BlobID=15038

development in the North Bayshore Area and has driven commuter shuttle growth for Google and other tech firms with co-located office space in Mountain View. Similarly, in winning approval for its new headquarters facility in Cupertino, Apple agreed to institute a TDM program. When fully instituted, Apple will reportedly operate 200 service routes a day with commuter shuttles, serving 1,600 employees[6].

While municipalities on the destination end of employee commute trips are working to develop policy tools to constrain single occupancy vehicle use and encourage, or mandate, the increased use of shuttles, communities on the origin end of employee commutes, notably San Francisco, have been working to limit their proliferation and impact. Under pressure from community members unhappy with the presence of large, private commuter shuttles operating on neighborhood streets, the San Francisco Municipal Transportation Agency (SFMTA) has begun regulating and the number and location of stops where employees are picked up and dropped off by shuttles. Such stops have been reduced to 110 from 125 and restricted to larger streets[7].

While the magnitude and immediate impact is difficult to determine, which is again due to the private nature of the shuttles, increasing evidence from TDM monitoring programs and other studies suggests that the reduction in employee shuttle stops has the effect of increasing single occupancy vehicle use by employees that were otherwise utilizing shuttles[8]. This push and pull of policy between communities at either end of employee shuttle trips demonstrates the challenge of coordinating transportation policy where costs and benefits are perceived to be so widely disconnected. Even if one community or collection of communities finds a benefit in a policy incentive, another may see it as a cost and restrict it. Without wider coordination, those policy tools are blunted.

Trends

Public transportation agencies, at times seen in competition or in conflict with employee shuttles, are increasingly integrating their service offerings with and around shuttle providers. Coordination is taking place both formally, through the formation of public private partnerships, and informally. Public transportation agencies in San Mateo County have partnered with tech employers to operate 51 employer shuttles carrying a reported 8.6 million employees a year[9]. Employers contribute roughly 50% of the funds to operate the shuttle services. However, unlike most private shuttle services which are restricted to employees of the providing employer, the partnership with public transportation agencies allows anyone to take advantage of the shuttle services regardless of their employment status with one of the sponsoring firms. Since the development of a managed lane in this corridor will be predicated on several policy considerations in addition to physical and operational considerations, it is recommended that corresponding policies around employee shuttles be reviewed more closely to identify synergies between these efforts to manage demand and more efficiently and effectively get people to their destinations.

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[6] *http://articles.latimes.com/2014/mar/30/business/la-fi-google-bus-20140330*
[7] *http://www.sfchronicle.com/opinion/editorials/article/SFMTA-has-the-right-compromise-on-tech-buses-8355529.php*
[8] *http://www.sfchronicle.com/business/article/More-tech-workers-driving-solo-after-SF-cuts-8350171.php*
[9] *http://articles.latimes.com/2014/mar/30/business/la-fi-google-bus-20140330*

Appendix B.1
FCMS GOALS & METRICS

NOTE: Proposed data sources shown in *(red)*.

FCMS Phase 1 Goal #1

Improve San Francisco freeway corridors' ability to move people (person throughput) to support economic competitiveness and accommodate existing and new residents and workers.

Objective	FCMS Phase 2 metrics
1.1 Improve freeway corridor productivity, utilization and efficiency.	• Person-Miles Traveled (PMT) *(Travel model only)* • Person-Hours Traveled (PHT) *(Travel model only)* • Person-Hours of Delay (PHD) *(Traffic analysis)* • Vehicle-Hours of Delay (VHD) *(Traffic analysis)* • Vehicle-Miles Traveled (VMT) *(Travel model only)* • Vehicle-Hours Traveled (VHT) *(Travel model only)* • Vehicle classification (incl. truck percentage for goods movement) *(Travel model, SFMTA, counts)*
1.2 Increase vehicle occupancy levels.	• Vehicle occupancy (SOVs vs. HOVs) *(Counts, travel model, traffic analysis)* • Shared-ride shuttle usage, carpools *(SFCTA, SFMTA, counts)*
1.3 Reduce recurring delays on freeway corridors.	• Person-Hours of Delay (PHD) *(Traffic analysis)* • Vehicle-Hours of Delay (VHD) *(Traffic analysis)*

FCMS Phase 1 Goal #2

*Improve **Trip Reliability** for all freeway corridor users & modes*

Objective	FCMS Phase 2 metrics
2.1 Improve travel time predictability on freeway corridors.	• Travel time for SOVs & HOVs on certain segments and trips (O&D needed) *(Inrix data [need expanded data set], traffic analysis)* • Buffer time index, planning time index *(Traffic analysis)*
2.2 Reduce non-recurrent delay due to incidents on freeway corridors.	• Number of incidents by incident type by time period by location *(Caltrans TMC, CHP)* • Incident clearance times *(Caltrans TMC)*

FCMS Phase 1 Goal #3

*Improve **Travel Mode Choices** for trips on freeway corridors that start or end in San Francisco.*

Objective	FCMS Phase 2 metrics
3.1 Increase transit competitiveness with the automobile in freeway corridors.	• Transit ridership on key routes *(Travel model, SFMTA)* • Transit/HOV reliability *(Travel model, traffic analysis)* • Transit travel time vs. auto on certain segments and trips *(Travel model, SFMTA, traffic analysis)* • Mode shift *(Counts, travel model, traffic analysis)*
3.2 Provide better traveler information.	• Number of venues for receiving traveler info multimodal *(SFMTA, Caltrans, MTC)* • O&D of trips in the corridor *(Travel model, survey of public awareness & access to info before & after?)*

FCMS Phase 1 Goal #4

*Support **Coordinated and Integrated** strategies and plans **across Jurisdictional Boundaries**, including Caltrans, MTC, and adjacent Counties.*

Objective	FCMS Phase 2 metrics
4.1 Integrate and coordinate FCMS recommendations with other San Francisco citywide transportation operations and demand management strategies.	• Listing of other citywide transportation operations and demand management strategies which we can qualitatively cross check FCMS strategies against *(SFMTA, bike routes, SFPD [enforcement])*
4.2 Coordinate San Francisco FCMS recommendations with the plans and projects of neighboring Counties, the region and Caltrans.	• Listing of other San Mateo County and regional operations and demand management strategies which we can qualitatively cross check FCMS strategies against *(Caltrans, MTC, SMCTA, C/CAG)*

FCMS Phase 1 Goal #5

Reduce per person freeway corridor traveler emissions

Objective	FCMS Phase 2 metrics
5.1 Reduce vehicle trip-making through increased occupancy, mode shift, and other means.	• Vehicle-Miles Traveled (VMT) *(Travel model only)* • Person-Miles Traveled (PMT) *(Travel model only)* • Vehicle occupancy (SOVs vs HOVs); mode shift *(Counts, travel model, traffic analysis)* • shared ride usage (shuttle, carpools) *(SFCTA, SFMTA, counts)*
5.2 Reduce average per person GHG emissions in the corridor	• GHG emissions per person and per vehicle (transit & auto) *(Travel model only)*

FCMS Phase 1 Goal #6

Ensure safe, equitable, and balanced local arterial and freeway operations, while minimizing traffic impacts on neighborhoods.

Objective	FCMS Phase 2 metrics
6.1 Mitigate the impacts of through-trips on local San Francisco streets	• Volumes on major street corridors *(Travel model, counts, analysis)* • Speed on local streets *(Traffic analysis, SFMTA)* • LOS on affected local intersections *(Traffic analysis, SFMTA)* • Bike & ped access for affected intersections *(Analysis, field observations)* • no. of collisions on local streets *(SWITRS, TASAS, SFMTA)*
6.2 Ensure equitable access and avoid disparities in distribution of benefits/impacts	• Household income for those making trips in corridor by mode, trip purpose by mode *(Travel model only)*

Appendix B.2
DATA METHODOLOGY

For budgetary and schedule reasons, this feasibility study was intended to be based primarily on data already available, with additional data collection to be conducted only where absolutely necessary and vital to be able to draw key technical conclusions. The information used to characterize existing conditions and issues was culled from a variety of sources, with each source collected at different dates. As a result, data discontinuities are both unavoidable and to be expected. Every attempt was made to establish as consistent and complete of a data set as possible. Where multiple sources were available for a specific location, judgement was exercised to select the source to use that best represented typical conditions.

In addition, it is acknowledged that there can be wide variation in day to day conditions, with differences by time of year, weekdays vs. weekends, and particular days of the week. Travel demands are affected by planned activities (such as sports events) or by unplanned events (accidents or inclement weather). For this feasibility study, it was decided to assess the operation of the proposed alternatives based on "typical" non-recurrent conditions on a Spring mid-week day. It should be recognized that although this may represent an average situation, conditions on some non-typical days can be worse. On days of major incidents either within the project area or on nearby freeway segments, traffic congestion and delays on the freeway and local streets can be considerably worse.

Traffic Counts

Freeway volume data was obtained from two primary sources: Caltrans PeMS and from a series of field counts conducted in May 2016 (see table below). PeMS was the primary source of mainline traffic volumes. Data from unreliable detector locations were screened out, based on PeMS detector health status information and through consultation with Caltrans staff. PeMS does not include ramp counts within the study area, so manual counts were conducted at numerous on and off-ramps in the study area (see Table B-1 below). Traffic volumes on the connectors at the 280/101 interchange in San Francisco were obtained through aerial photography.

Table B-1: Field Data Collection conducted for this study

Freeway	Dir	Type	Location	Source	Count Date
I-280	SB	On-ramp	5th & King	Manual	5/18/2016
I-280	SB	On-ramp	6th & Brannan	Manual	5/19/2016
I-280	SB	Off-ramp	18th / Pennsylvania	Pier 70 TIS (2014)	N/A
I-280	SB	On-ramp	Mariposa	Manual	5/18/2016
I-280	SB	Off-ramp	25th / Pennsylvania	Pier 70 TIS (2014)	N/A
I-280	SB	On-ramp	Cesar Chavez / Pennsylvania	Manual	5/19/2016
I-280	SB	Fwy connector	SB 280 through lanes	Aerial	AM on 5/18/2016
I-280	SB	Fwy connector	SB 280 to SB 101	Aerial	PM on 5/17/2016
I-280	NB	Fwy connector	NB 280 to SB 101	Aerial	

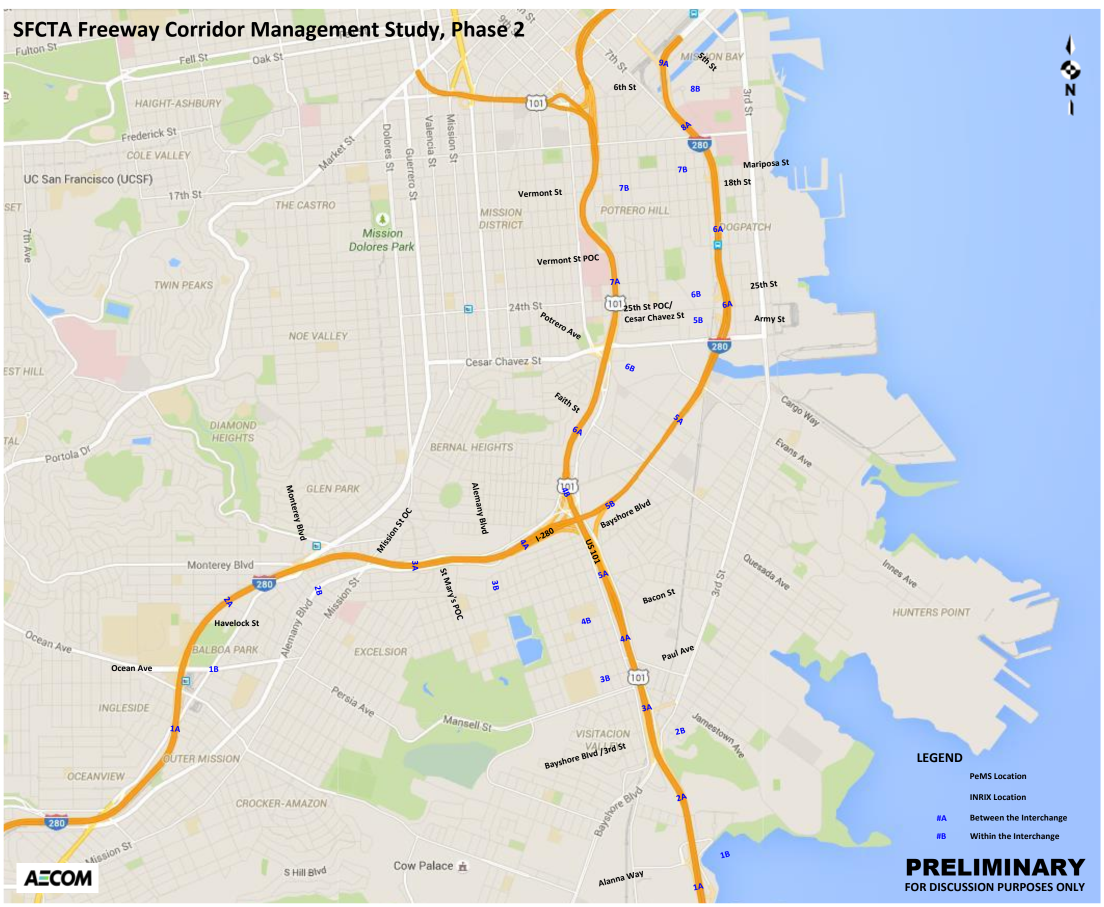
Freeway	Dir	Type	Location	Source	Count Date
I-280	NB	Fwy connector	NB 280 to NB 101	Aerial	
I-280	NB	Fwy connector	NB 280 through lanes	Aerial	
I-280	NB	Off-ramp	5th & King	Manual	5/18/2016
I-280	NB	Off-ramp	6th & Brannan	Manual	5/19/2016
US 101	SB	Fwy connector	SB 101 to SB 280	Aerial	AM 5/18/2016
US 101	SB	Mainline	Just s/o of SB 280 diverge	Aerial	PM 5/17/2016
US 101	SB	Off-ramp	Alemany Blvd	Aerial	
US 101	SB	On-ramp	Alemany Blvd	Aerial	
US 101	SB	Off-ramp	Silver Ave	Aerial	
US 101	SB	On-ramp	Silver Ave	Aerial	
US 101	SB	Mainline	Burrows St.	Aerial	
US 101	SB	Off-ramp	Paul Ave	Manual	5/18/2016
US 101	SB	Off-ramp	3rd Street	Aerial	AM on 5/18/2016
US 101	SB	On-ramp	3rd Street	Aerial	PM on 5/17/2016
US 101	SB	Off-ramp	Tunnel Ave.	Manual	5/18/2016
US 101	NB	Off-ramp	3rd Street	Aerial	AM on 5/18/2016 PM on 5/17/2016
US 101	NB	Mainline	Just N. of 3rd Street off-ramp	Aerial	
US 101	NB	Off-ramp	Paul Ave	Aerial	
US 101	NB	On-ramp	Bayshore Blvd	Aerial	
US 101	NB	Fwy connector	NB 101 to NB 280	Aerial	
US 101	NB	Fwy connector	NB 101 to SB 280	Aerial	
US 101	NB	Off-ramp	Silver Ave	Aerial	
US 101	NB	Off-ramp	Alemany Blvd	Aerial	
US 101	NB	On-ramp	Alemany Blvd	Aerial	

Appendix B.3
FREEWAY SPEEDS

Freeway Speeds & Travel Times

INRIX data was the primary source of freeway speeds. This data set was provided by SFCTA, from which it was decided to use weekday data from March and April 0f 2015 to represent a "typical" time of year not affected by major holidays or Summer vacations. Speed data from the Caltrans Performance Measurement System (PeMS) was also extracted, and used mainly to verify the speed and congestion trends observed from the INRIX data. The June 2016 San Mateo County US 101 Ramp Metering Project "After" Study conducted floating car runs within the San Mateo County portions of US 101, from which the speed plots were consulted to verify bottleneck and congestion locations. A travel time survey was conducted on April 21, 2016 along US 101 between Harney Way near the former Candlestick Park and I-80 junction during the morning peak (6:00AM to 10:00AM) and in the evening peak (3:00PM to 7:00PM). Similarly, a travel time survey was conducted on I-280 between Ocean Avenue and the end of the freeway at Fourth/King St on April 28, 2016. The travel time surveys generated speed profiles for both freeways during the two four-hour periods and made observations of the traffic conditions from which speed data from other sources (INRIX and PeMS) were corroborated.

Figure C-1 San Francisco Speed Segments



Northbound SF-101; Average Speeds and Volumes

Freeway	Segment	Location	ID	Data	Speed / Volume	Average Speed and Volume																								ADT
						12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM	
US 101 NB	1A	Approaching Alanna Way	105+04181	INRIX	Speed	66	66	66	66	67	68	64	57	46	54	62	65	65	66	66	66	65	59	57	62	65	64	67	67	
	1B	Alanna Way Interhange	105P04181	INRIX	Speed	66	65	65	65	66	68	64	56	44	52	62	65	66	66	66	66	65	60	59	63	65	64	66	67	
	2A	Approaching 3rd St/Bayshore Blvd	105+04182	INRIX	Speed	64	63	64	62	65	66	63	54	41	48	60	63	64	65	64	64	63	59	59	62	63	63	64	65	
	2B		105P04182	INRIX	Speed	64	65	66	64	64	64	63	45	30	38	58	62	63	64	62	63	60	53	58	62	61	62	62	63	
		3rd St/Bayshore Blvd Interchange	401798	PeMS	Speed	71	71	70	69	70	70	65	46	30	40	61	66	66	67	68	69	65	58	65	68	68	71	71	70	
					Volume	1,334	741	524	609	1,239	3,031	5,578	6,951	6,491	5,948	5,708	5,573	5,732	5,730	6,002	5,865	6,609	7,121	7,015	6,164	5,300	4,592	3,576	2,272	109,704
	3A	Approaching Paul Ave	105+04183	INRIX	Speed	65	66	66	65	65	65	61	38	24	32	55	61	63	62	60	60	55	47	56	61	61	62	63	63	
	3B		105P04183	INRIX	Speed	64	65	67	65	64	65	61	39	24	32	55	61	63	62	59	60	56	49	57	61	61	61	63	63	
		Paul Ave Interchange	401358	PeMS	Speed	72	71	71	71	71	71	65	41	30	44	62	66	67	67	65	65	60	56	63	67	68	70	71	69	
					Volume	1,091	624	539	687	1,421	3,381	6,606	8,018	7,840	7,440	6,917	6,612	6,586	6,821	7,731	7,908	8,162	8,301	7,938	6,599	5,279	4,570	3,433	2,261	126,764
	4A	Approaching Bacon St	105+04184	INRIX	Speed	64	65	67	65	65	65	60	39	24	32	55	61	63	62	59	60	56	50	57	61	61	62	63	63	
	4B		105P04184	INRIX	Speed	68	67	69	67	67	68	62	40	26	34	56	63	64	65	63	64	62	59	62	65	65	66	67	67	
		Bacon Street Interchange	400255	PeMS	Speed	71	71	70	69	70	71	64	47	35	41	58	64	66	66	64	65	64	62	64	67	68	69	71	71	
					Volume	1,429	809	611	729	1,463	3,507	6,533	8,035	7,478	7,116	6,865	6,642	6,688	6,625	6,825	6,690	7,405	8,005	7,648	6,614	5,659	4,946	3,854	2,463	124,638
	5A	Approaching I-280/Alemany Blvd	105+04185	INRIX	Speed	65	66	67	65	65	65	61	39	24	32	55	62	63	63	59	60	57	51	58	61	62	63	64	64	
	5B	I-280/Alemany Blvd Interchange	105P04185	INRIX	Speed	62	63	63	63	63	63	60	29	17	22	43	56	60	57	43	53	57	54	56	60	58	60	61	61	
		Bayshore Blvd	401934	PeMS	Speed	67	67	66	66	67	68	59	28	16	22	45	58	60	60	56	65	66	64	64	65	64	67	68	68	
					Volume	1,029	573	407	468	923	2,133	3,979	4,260	[illegible]	3,817	3,964	3,971	4,063	3,740	3,155	2,989	3,392	3,913	3,901	3,690	3,426	3,213	2,613	1,714	69,013
	6A	Approaching Potrero Ave	105+04186	INRIX	Speed	60	61	61	60	61	61	55	26	18	20	33	46	56	46	20	23	34	34	44	52	48	54	58	59	
		Faith St	401277	PeMS	Speed	65	65	65	64	64	65	56	39	34	34	42	51	57	51	33	33	36	38	47	55	55	61	63	65	
					Volume	1,703	1,193	1,023	1,111	1,704	3,556	5,863	6,456	6,014	5,928	5,802	5,727	5,752	5,160	4,171	3,926	4,129	4,628	4,836	4,628	4,433	4,478	3,805	2,567	98,592
	6B	Potrero Ave Interchange	105P04186	INRIX	Speed	62	63	62	61	62	62	55	29	22	22	31	42	55	39	13	12	15	21	36	45	43	52	57	60	
	7A	Approaching Vermont St	105+04187	INRIX	Speed	58	61	61	59	60	57	52	40	34	36	40	44	49	31	11	9	9	15	25	34	37	46	50	53	
		25th St POC/Cesar Chavez St	400868	PeMS	Speed	69	68	68	68	68	70	55	32	26	27	32	44	56	40	13	11	12	20	38	46	48	61	65	69	
					Volume	1,319	743	548	643	1,278	3,171	6,033	6,824	6,468	6,326	6,015	5,765	5,770	4,928	[illegible]	[illegible]	[illegible]	3,752	4,146	4,303	4,280	4,335	3,612	2,254	92,315
		Vermont St POC	401409	PeMS	Speed	66	64	64	63	65	66	59	51	48	49	50	53	57	49	32	29	30	36	46	51	52	62	64	65	
					Volume	2,235	1,570	1,381	1,473	2,137	4,192	7,330	8,432	8,081	7,965	7,754	7,529	7,539	6,473	4,814	4,342	4,376	5,074	5,413	5,575	5,551	5,619	4,801	3,333	122,988
	7B	Vermont St Interchange	105P04187	INRIX	Speed	57	59	59	58	58	56	53	44	38	43	46	47	48	29	12	11	10	13	20	29	35	43	46	50	

Southbound SF-101; Average Speeds and Volumes

Freeway	Segment	Location	ID	Data	Speed / Volume	Average Speed and Volume																								ADT
						12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM	
US 101 SB	8A	Approaching Vermont St	105-04187	INRIX	Speed	55	59	61	61	58	58	50	44	48	46	43	41	37	36	32	30	29	28	28	36	48	49	50	52	
	7B	Vermont St Interchange	105N04187	INRIX	Speed	56	60	61	60	58	58	53	48	50	50	48	48	46	45	43	41	39	38	40	45	51	52	52	53	
	7A	Approaching Potrero Ave	105-04186	INRIX	Speed	60	63	63	62	61	62	58	55	53	55	56	56	54	54	54	54	52	51	52	55	57	58	57	58	
		Vermont St POC	401410	PeMS	Speed	66	66	66	65	66	66	64	61	60	61	60	61	60	61	62	63	62	60	61	63	64	66	64	64	
					Volume	2302	1525	1193	1058	1660	3554	5981	6743	6179	6234	6553	6657	6727	6539	6779	6932	6993	7049	6965	6525	5934	5797	5269	3961	125,110
		25th St POC/Cesar Chavez St	400043	PeMS	Speed	67	68	68	68	70	70	67	63	62	66	65	65	64	65	66	66	64	60	60	65	65	68	69	69	
					Volume	1725	1057	821	823	1575	3224	5316	5807	5276	5517	5718	5794	5824	5747	6020	6220	6432	6619	6348	5860	5243	5094	4488	3307	109,854
	6B	Potrero Ave Interchange	105N04186	INRIX	Speed	61	64	64	64	64	65	62	56	54	60	61	61	60	60	61	60	58	55	55	59	60	60	60	61	
	6A	Approaching I-280/Alemany Blvd	105-04185	INRIX	Speed	60	63	62	62	63	64	60	47	44	57	59	59	58	58	60	58	57	53	53	58	59	59	59	60	
		Faith St	401285	PeMS	Speed	65	65	65	65	65	66	63	58	59	63	62	62	61	62	62	63	62	58	60	62	63	64	64	64	
					Volume	2282	1609	1330	1217	1693	3157	5223	6166	5818	5818	5990	6133	6129	6067	6338	6615	6778	6814	6640	6205	5619	5533	4895	3676	117,745
	5B	I-280/Alemany Blvd Interchange	105N04185	INRIX	Speed	60	61	60	60	61	62	58	37	35	52	58	58	58	59	59	59	59	58	58	59	58	59	58	58	
		Bayshore Blvd	401935	PeMS	Speed	67	66	65	66	68	69	62	43	43	60	63	63	64	65	66	66	66	65	65	66	65	68	68	67	
					Volume	1390	934	817	911	1613	3192	5317	5700	5382	5339	5118	5061	4948	4976	5094	5327	5482	5525	5278	4880	4360	4167	3529	2531	96,870
	5A	Approaching Bacon St	105-04184	INRIX	Speed	64	65	64	64	64	65	61	38	35	52	61	61	62	63	62	63	62	61	61	62	61	61	61	61	
	4B	Bacon Street Interchange	105N04184	INRIX	Speed	64	65	64	64	65	65	61	37	35	52	61	61	62	63	62	62	62	61	62	62	61	62	61	62	
	4A	Approaching Paul Ave	105-04183	INRIX	Speed	64	64	64	64	64	65	62	37	35	52	63	63	63	64	63	62	62	61	62	63	62	63	61	61	
	3B		105N04183	INRIX	Speed	64	65	64	64	64	65	62	36	34	51	63	63	63	64	63	62	62	61	62	64	63	63	61	61	
		Paul Ave Interchange	401357	PeMS	Speed	71	71	70	70	70	70	65	46	37	47	62	66	66	67	67	68	67	66	67	68	68	70	71	70	
					Volume	1567	946	735	801	1460	3121	5764	7474	7051	6233	5806	5766	5829	5634	5362	5429	6064	6541	6163	5493	5060	4814	3903	2681	109,698
	3A	Approaching 3rd St/Bayshore Blvd	105-04182	INRIX	Speed	64	65	65	64	64	65	62	35	33	49	62	63	63	63	63	62	61	61	62	63	63	63	62	61	
	2B		105N04182	INRIX	Speed	65	65	64	64	64	65	63	30	29	44	62	63	63	64	64	63	62	62	63	64	64	64	64	63	
		3rd St/Bayshore Blvd Interchange	401454	PeMS	Speed	67	67	66	66	68	69	64	31	30	43	62	63	64	64	64	64	62	63	65	66	65	68	68	67	
					Volume	1120	655	607	775	1559	3193	5884	6684	6676	6289	5580	5398	5448	5562	5928	6191	6164	6180	5882	5221	4422	4183	3386	2388	105,376
	2A	Approaching Alanna Way	105-04181	INRIX	Speed	66	65	64	66	67	67	64	31	29	42	61	65	64	66	65	63	63	63	65	66	66	66	66	67	
	1B	Alanna Way Interhange	105N04181	INRIX	Speed	66	66	64	65	68	69	65	45	43	51	64	66	65	67	66	64	64	64	65	67	67	67	68	68	

LEGEND

- ≤ 19 mph
- 20 - 39 mph
- 40 - 59 mph
- ≥ 60 mph

Northbound SF-280; Average Speeds and Volumes

Freeway	Segment	Location	ID	Data	Speed / Volume	Average Speed and Volume																								ADT
						12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM	
I-280 NB	1A	Approaching Ocean Ave	105+04865	INRIX	Speed	65	67	66	66	67	66	65	49	31	58	66	67	66	66	66	66	65	65	66	66	66	65	66	66	
	1B		105P04865	INRIX	Speed	65	65	66	66	67	66	65	46	29	56	65	66	65	66	66	66	65	65	66	66	65	65	65	66	
		Ocean Ave Interchange	404618	PeMS	Speed	69	69	70	70	70	70	67	51	42	59	63	63	63	63	63	62	60	59	59	61	65	68	68	69	
					Volume	1119	699	614	652	987	2055	4462	6910	5961	5362	4385	4388	4625	4743	5388	5493	5930	6349	5979	5035	4123	3703	2879	1850	93,689
	2A	Approaching Monterey Blvd	105+04866	INRIX	Speed	66	67	66	66	67	66	65	43	25	53	66	66	66	66	66	66	65	65	66	66	66	65	66	66	
		Havelock St	400156	PeMS	Speed	68	67	67	68	68	69	69	61	54	65	68	69	68	68	68	68	68	68	68	69	69	69	69	68	
					Volume	852	588	506	625	1086	2856	6091	7801	6621	5867	4938	4495	4472	4675	4841	4842	5023	5013	4874	4206	3554	3283	2496	1365	90,967
	2B		105P04866	INRIX	Speed	66	66	66	66	66	65	65	35	19	46	65	66	67	67	67	66	66	67	67	66	66	65	64	66	
		Monterey Blvd Interchange	400676	PeMS	Speed	68	67	67	68	68	68	64	34	19	50	65	66	67	67	67	68	67	68	67	67	68	68	68	68	
					Volume	630	415	346	445	827	2288	4967	6223	5400	4700	3950	3611	3627	3752	3753	3683	3777	3724	3680	3225	2845	2665	2008	1097	71,638
	3A	Appraoching Alemany Blvd	105+04867	INRIX	Speed	65	66	65	65	65	65	63	31	18	40	64	65	66	65	65	66	65	66	67	66	65	56	57	64	
		Mission St OC	401486	PeMS	Speed	65	65	65	65	65	65	62	38	26	48	63	63	64	63	64	64	64	65	64	64	65	65	65	65	
					Volume	826	614	548	636	990	2287	4645	5803	5207	4655	3831	3609	3606	3805	3980	3921	3999	3911	3729	3271	2874	2739	2168	1258	72,912
		At Mary's Playground POC	400575	PeMS	Speed	66	66	67	67	68	70	64	29	18	42	63	64	64	64	64	65	64	65	65	65	65	55	55	64	
					Volume	649	429	359	478	878	2387	5157	6078	[illegible]	4911	4000	3625	3578	3682	3592	3401	3474	3361	3366	3069	2674	2350	1826	1078	69,789
	3B		105P04867	INRIX	Speed	63	64	64	64	64	65	62	29	19	37	63	64	66	64	65	66	65	66	67	66	65	52	49	59	
		Alemany Blvd Interchange	400322	PeMS	Speed	63	63	63	63	63	64	60	42	33	49	61	62	62	61	61	61	61	62	61	62	63	61	60	63	
					Volume	760	607	571	640	935	2052	4108	5344	4885	4260	3492	3281	3163	3507	3831	3747	3833	3714	3636	3159	2621	2287	1832	1117	67,383
	4A	Approaching US 101	105+04868	INRIX	Speed	61	63	63	62	63	63	59	29	20	34	61	63	64	62	63	64	64	65	64	64	62	56	53	58	
	4B	US 101 Interchange	105P04868	INRIX	Speed	59	60	59	59	59	60	57	38	28	39	58	60	62	60	58	59	60	61	61	60	59	56	54	56	
	5A	Approaching Army St	105+04869	INRIX	Speed	63	60	60	60	61	62	59	52	42	47	58	60	61	60	57	58	57	58	59	61	59	60	61	60	
	5B	Army St Interchange	105P04869	INRIX	Speed	65	61	61	62	63	62	62	59	54	54	62	64	62	62	59	59	59	59	61	63	63	63	64	63	
	6A	Approaching 25th St	105+04870	INRIX	Speed	64	62	61	62	62	64	63	59	55	52	62	64	63	62	57	56	58	57	59	63	62	62	64	63	
	6B	25th St Interchange	105P04870	INRIX	Speed	65	63	63	63	63	64	62	58	52	47	59	63	62	62	52	51	56	55	58	61	61	61	62	62	
	7A	Approaching Mariposa St	105+04871	INRIX	Speed	66	64	65	63	63	63	61	56	46	40	55	62	62	61	46	46	50	52	56	59	60	60	62	63	
		18th St	400573	PeMS	Speed	67	67	67	67	68	68	66	60	51	52	63	66	66	65	55	58	61	62	62	65	67	67	67	67	
					Volume	373	234	197	242	512	1497	2948	4455	4180	3565	3034	2794	2674	3024	3764	3638	3844	3692	3415	2843	2219	1667	1251	704	56,764
	7B	Mariposa St Interchange	105P04871	INRIX	Speed	65	64	65	64	63	63	61	51	35	32	51	60	61	59	39	40	43	44	50	56	59	60	61	63	
	8A	Approaching 6th St	105+04872	INRIX	Speed	64	63	64	62	61	60	59	37	20	17	42	57	58	55	27	26	31	26	40	50	56	57	59	60	
	8B	6th St Interchange	105P04872	INRIX	Speed	39	32	29	33	42	50	51	25	12	11	29	47	52	51	19	16	20	13	26	41	49	49	50	46	
	9A	Approaching 5th St	105+04873	INRIX	Speed	31	28	28	28	34	38	33	13	9	9	15	23	30	29	12	10	11	9	12	20	31	33	36	34	

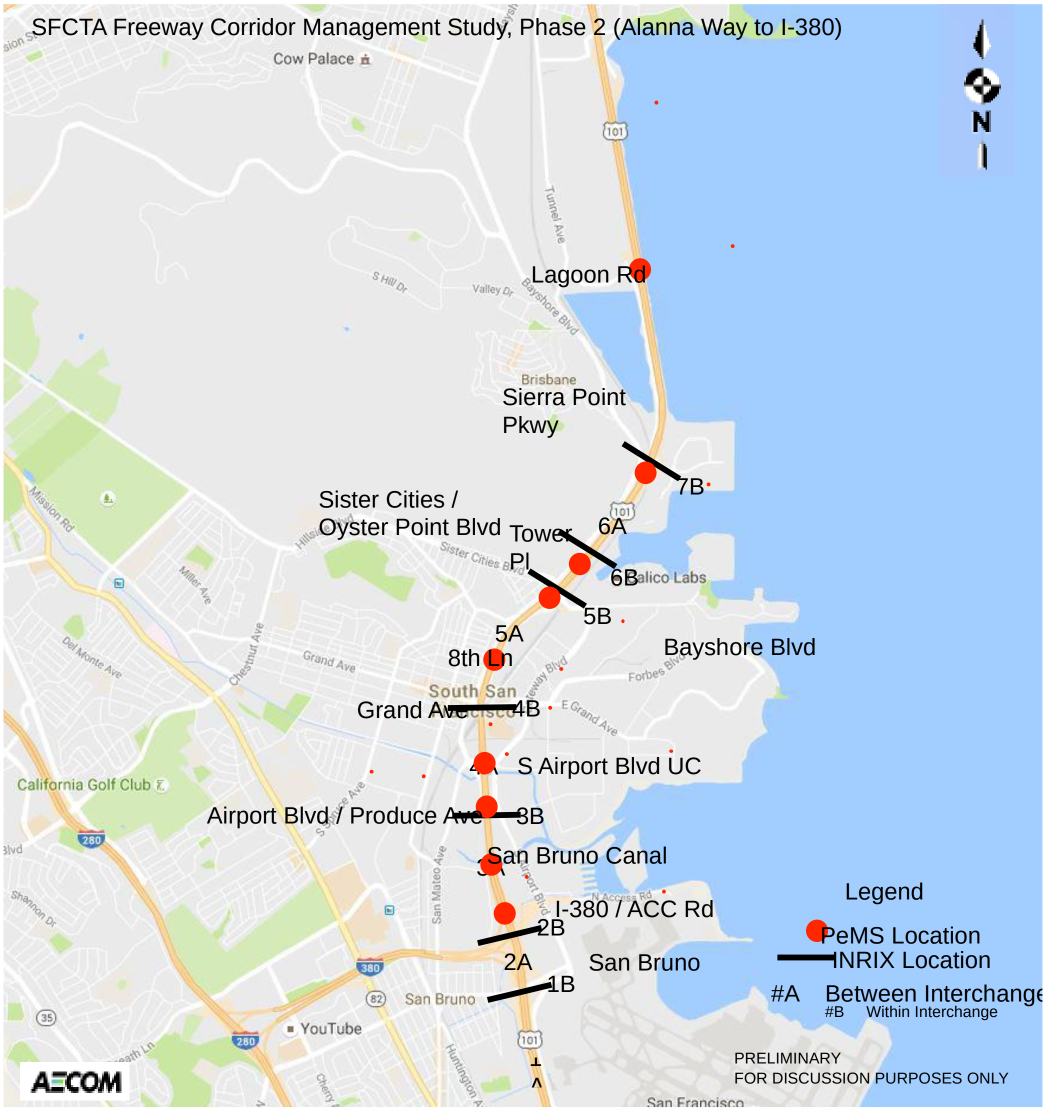
Southbound SF-280; Average Speeds and Volumes

Freeway	Segment	Location	ID	Data	Speed / Volume	Average Speed and Volume																								ADT
						12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM	
I-280 SB	9A	Approaching 6th St	105+04872	INRIX	Speed	35	34	31	30	32	38	35	32	32	33	35	37	39	37	36	41	37	35	32	33	35	36	37	36	
	8B	6th St Interchange	105P04872	INRIX	Speed	41	37	33	33	34	46	43	42	43	46	49	51	51	50	52	56	54	48	51	51	50	49	48	45	
	8A	Approaching Mariposa St	105+04871	INRIX	Speed	62	64	64	64	63	61	60	60	59	58	59	60	60	60	60	60	59	50	57	60	60	59	60	60	
	7B	Mariposa St Interchange	105P04871	INRIX	Speed	63	64	64	64	63	63	61	63	61	61	62	62	62	62	62	62	59	41	57	62	62	61	59	59	
	7A	Approaching 25th St	105+04870	INRIX	Speed	63	65	64	64	64	63	62	62	62	62	62	63	62	62	62	59	55	32	51	61	61	61	57	59	
		18th St	400231	PeMS	Speed	67	67	67	67	67	67	68	67	68	67	67	67	67	67	67	65	63	38	60	68	68	67	68	68	
					Volume	476	280	202	166	301	587	1,289	2,168	2,084	1,871	1,792	1,777	1,913	2,012	2,569	2,957	3,234	3,253	3,010	2,305	1,733	1,587	1,260	893	39,719
	6B	25th St Interchange	105P04870	INRIX	Speed	59	62	61	61	62	60	59	62	62	60	63	64	64	62	63	59	51	26	47	62	62	60	49	55	
	6A	Approaching Army St	105+04869	INRIX	Speed	59	62	60	61	62	62	61	63	65	64	63	65	64	62	64	57	49	26	46	63	63	62	46	53	
	5B	Army St Interchange	105P04869	INRIX	Speed	58	62	60	60	61	60	59	62	63	62	63	64	63	61	63	56	48	27	46	62	62	61	44	51	
	5A	Approaching US 101	105+04868	INRIX	Speed	56	60	59	60	59	57	58	60	62	62	62	62	61	60	61	55	53	43	53	61	61	61	35	45	
	4B	US 101 Interchange	105P04868	INRIX	Speed	57	59	58	59	59	58	60	60	60	61	61	60	61	60	60	56	57	45	50	60	60	59	54	54	
	4A	Appraoching Alemany Blvd	105+04867	INRIX	Speed	62	62	63	63	61	63	63	63	63	63	63	62	63	63	62	59	58	36	43	60	60	61	61	61	
	3B		105P04867	INRIX	Speed	63	62	63	63	62	63	63	64	64	64	64	63	64	64	64	59	59	32	38	61	61	62	62	63	
		Alemany Blvd Interchange	401018	PeMS	Speed	62	62	62	62	62	62	62	62	62	62	62	62	62	62	61	59	58	38	47	61	62	63	63	63	
					Volume	1,907	1,506	1,370	1,220	1,329	1,739	2,747	4,053	3,932	3,925	3,955	4,036	4,226	4,288	4,930	5,527	5,917	5,541	5,289	4,676	3,901	3,661	3,279	2,737	85,692
	3A	Approaching Monterey Blvd	105+04866	INRIX	Speed	64	63	64	64	62	63	63	61	58	62	62	62	62	63	61	48	55	32	36	56	59	61	62	63	
		At Mary's Playground POC	400552	PeMS	Speed	66	66	66	66	66	66	67	66	66	66	66	66	67	66	66	61	59	30	40	65	65	67	67	67	
					Volume	1,187	678	510	347	455	858	1,873	3,322	3,105	3,178	3,340	3,450	3,675	3,764	4,656	5,665	6,363	6,170	5,651	4,561	3,562	3,268	2,764	2,196	74,600
		Mission St OC	401470	PeMS	Speed	62	62	62	62	62	62	62	62	62	63	63	63	63	63	61	58	58	44	50	61	62	63	63	63	
					Volume	1,619	1,258	1,117	964	1,072	1,408	2,270	3,763	3,661	3,709	3,801	3,899	4,113	4,128	4,883	5,774	6,228	5,929	5,525	4,614	3,705	3,474	3,110	2,531	82,554
	2B		105P04866	INRIX	Speed	65	65	65	65	63	63	63	63	62	63	63	63	64	64	61	57	60	50	52	60	59	63	64	64	
		Monterey Blvd Interchange	400318	PeMS	Speed	68	68	68	66	67	68	68	67	68	68	67	67	68	67	66	63	62	59	61	66	67	68	68	68	
					Volume	1,165	679	513	376	450	814	1,788	3,450	3,366	3,312	3,390	3,470	3,681	3,748	4,567	5,709	6,124	6,112	5,497	4,291	3,312	3,042	2,636	2,134	73,625
	2A	Approaching Ocean Ave	105+04865	INRIX	Speed	65	66	65	65	63	63	62	62	62	63	62	63	63	63	63	61	59	57	59	61	61	62	64	64	
		Havelock St	400397	PeMS	Speed	67	66	66	65	65	65	58	62	62	61	60	61	62	62	63	63	63	63	63	61	60	68	69	68	
					Volume	2,994	2,523	2,357	2,145	2,212	2,787	4,071	6,208	6,305	6,291	6,048	5,882	5,871	5,919	6,719	7,985	8,487	8,632	7,940	6,670	5,543	5,114	4,544	3,871	127,118
	1B		105P04865	INRIX	Speed	65	66	65	65	63	63	62	65	65	65	64	63	64	64	65	62	62	60	60	62	62	63	65	65	
		Ocean Ave Interchange	404648	PeMS	Speed	68	69	69	69	69	70	70	69	68	68	68	68	68	68	68	66	65	64	64	68	68	68	68	68	
					Volume	1,088	746	705	653	808	1,346	3,113	5,010	4,397	4,106	3,432	3,351	3,545	3,606	4,226	4,795	5,391	5,879	5,279	4,005	2,980	2,657	2,190	1,665	74,973

LEGEND

- ≤ 19 mph
- 20 - 39 mph
- 40 - 59 mph
- ≥ 60 mph

Figure C-2 San Mateo Speed Segments



Northbound SM-101; Average Speeds

Freeway	Segment	Location	ID	Data	Speed / Volume	Average Speed and Volume																							
						12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
US 101 NB	1A	Approaching San Bruno Ave	105+06442	INRIX	Speed	64	65	65	64	63	64	64	62	58	60	62	63	62	62	62	60	59	46	46	61	61	62	62	63
	1B	San Bruno Ave	105P06442	INRIX	Speed	66	66	65	65	66	67	66	61	55	61	65	66	66	66	66	65	64	49	43	63	64	64	65	66
	2A	Approaching I-380 / ACC Rd	105+04174	INRIX	Speed	66	66	65	65	65	66	65	62	58	61	64	65	64	64	64	62	61	47	46	63	62	63	64	65
	2B	I-380 / ACC Rd	105P04174	INRIX	Speed	66	65	65	65	65	67	66	59	52	60	65	66	65	66	65	65	64	47	40	63	64	63	64	65
	3A	Approaching Airport Blvd / Produce Ave	105+04175	INRIX	Speed	65	65	64	65	64	65	63	52	43	56	62	63	62	63	63	63	61	39	33	59	62	61	62	64
	3B	Aiport Blvd / Produce Ave	105P04175	INRIX	Speed	66	67	67	67	66	67	65	52	44	58	63	64	64	63	64	65	63	37	32	59	63	62	63	65
	4A	Approaching Grand Ave	105+04176	INRIX	Speed	65	66	67	67	65	66	63	51	45	56	62	63	62	62	62	63	62	36	32	58	62	62	62	65
	4B	Grand Ave	105P04176	INRIX	Speed	65	65	65	66	65	65	63	53	47	57	61	62	60	61	61	62	61	38	37	58	61	62	63	64
	5A	Approaching Sister Cities / Oyster Poi	105+04177	INRIX	Speed	65	65	65	65	65	66	64	54	47	59	62	62	60	62	62	62	62	38	39	59	63	64	64	65
	5B	Sister Cities / Oyster Poi	105P04177	INRIX	Speed	68	68	67	67	68	68	66	56	44	59	65	64	62	65	66	67	65	44	45	61	66	67	66	68
	6A	Appoaching Bayshore Blvd	105+04178	INRIX	Speed	67	67	67	67	66	67	65	53	43	58	64	62	61	64	64	64	64	40	40	59	65	66	65	67
	6B	Bayshore Blvd	105P04178	INRIX	Speed	68	67	67	67	68	68	66	55	44	59	65	64	62	65	65	66	65	43	44	61	66	67	66	68
	7A	Approaching Sierra Point Pkwy	105+04179	INRIX	Speed	67	67	66	66	67	67	65	55	41	56	63	62	61	64	66	66	65	46	45	59	65	66	65	66
	7B	Sierra Point Pkwy	105P04179	INRIX	Speed	67	67	66	66	67	67	65	55	41	56	63	62	61	64	66	66	65	46	45	59	65	66	65	66

Southbound SM-101; Average Speeds

Freeway	Segment	Location	ID	Data	Speed / Volume	Average Speed and Volume																							
						12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
US 101 SB	7B	Sierra Point Pkwy	105N04179	INRIX	Speed	66	66	65	66	66	67	66	62	62	63	65	65	65	65	64	64	64	61	62	65	66	66	67	67
	7A	Approaching Sierra Point Pkwy	105-04179	INRIX	Speed	67	66	65	66	67	68	66	62	61	62	65	65	65	66	65	65	65	63	64	66	67	67	68	68
	6B	Bayshore Blvd	105N04178	INRIX	Speed	67	66	65	66	66	67	67	65	63	64	65	66	66	65	65	64	64	58	61	66	66	66	67	68
	6A	Appoaching Bayshore Blvd	105-04178	INRIX	Speed	66	66	66	66	67	68	66	62	64	64	66	66	66	66	64	65	64	59	63	65	66	67	67	67
	5B	Sister Cities / Oyster Poi	105N04177	INRIX	Speed	65	65	64	65	65	67	66	63	64	64	65	65	65	65	65	64	63	54	61	65	65	65	66	67
	5A	Approaching Sister Cities / Oyster Poi	105-04177	INRIX	Speed	66	66	65	66	67	67	66	63	63	64	65	66	65	65	64	64	64	59	62	65	65	66	66	67
	4B	Grand Ave	105N04176	INRIX	Speed	64	65	64	64	64	65	64	61	62	62	63	63	62	63	62	61	58	49	57	62	62	63	64	65
	4A	Approaching Grand Ave	105-04176	INRIX	Speed	64	63	62	63	64	65	65	61	62	62	63	64	63	63	63	62	59	49	57	63	63	63	64	65
	3B	Aiport Blvd / Produce Ave	105N04175	INRIX	Speed	66	66	65	65	64	65	64	62	63	62	63	63	63	64	63	61	58	54	60	62	63	64	64	65
	3A	Approaching Airport Blvd / Produce Ave	105-04175	INRIX	Speed	64	65	64	64	63	64	63	60	61	61	61	62	61	62	61	59	56	47	56	61	61	62	62	64
	2B	I-380 / ACC Rd	105N04174	INRIX	Speed	66	67	67	65	65	66	67	66	65	65	66	66	66	66	60	50	52	56	64	67	66	67	67	67
	2A	Approaching I-380 / ACC Rd	105-04174	INRIX	Speed	65	66	66	64	62	63	62	60	61	61	61	61	61	62	61	59	57	55	59	61	62	62	63	64
	1B	San Bruno Ave	105N06442	INRIX	Speed	66	67	67	66	66	67	67	67	66	66	67	67	67	67	60	48	51	55	64	68	67	68	68	68
	1A	Approaching San Bruno Ave	105-06442	INRIX	Speed	65	66	66	64	62	63	63	62	63	63	63	63	63	63	62	60	59	58	63	63	62	63	63	65

LEGEND

- ≤ 19 mph
- 20 - 39 mph
- 40 - 59 mph
- ≥ 60 mph

Appendix B.4
TRAFFIC ANALYSIS METHODOLOGY

EXISTING CONDITIONS

Existing conditions were documented to characterize (to the greatest extent possible given readily-available data) traffic conditions and physical configurations of the freeways within the study limits. This information will be used to reach agreement on current operational characteristics and constraints from which the analysis of project alternative(s) will be conducted, as well as establish the basis for screening of alternatives. Existing mainline and ramp volumes along US 101 and I-280 was compiled from PeMS, Caltrans Census data, and new counts conducted as a part of this project. Speed information from INRIX was provided by SFCTA, and data from March & April 2015 was used to represent average speeds across all lanes of traffic. AECOM also performed floating car runs in April 2016 along US 101 from Candlestick Park to the I-80 split and I-280 from Geneva Avenue to King Street during the AM and PM peak periods to verify the INRIX speed data, and to directly observe bottleneck locations and queue lengths. No travel time runs were performed along the US 101 from I-380 to Candlestick Park because this segment was added to the study area later, once summer vacation for local schools had begun.

Based on the travel time runs and field observations, the consultant team identified recurring bottleneck locations and causes of the bottlenecks. For each bottleneck location, the consultant team estimated bottleneck outputs using PeMS data. Travel times and corresponding delays leading to each bottleneck were extracted from the floating car runs, and compared with INRIX for corroboration. The output and delay data were then used to compute hourly demand rates for each bottleneck (i.e. the number of vehicles per hour that exceed the capacity of the bottleneck which causes the resulting congestion). Peak hourly demands for freeway sections upstream and downstream of the bottlenecks were then calculated by adding and subtracting adjacent on and off-ramp volumes. The estimated hourly "unconstrained" freeway demand (i.e. the number of vehicles that would appear at each freeway section if not constrained by upstream bottlenecks). This allows for the identification of bottlenecks that may be "hidden" by queuing from a downstream bottleneck, or new downstream bottlenecks that may appear if the controlling bottlenecks are relieved. These peak hourly demands were also used to calculate demand to capacity (D/C) ratios. The operational analysis period was from 6-9 AM and 3-6 PM.

FUTURE CONDITIONS

These estimated demand volumes will also be used to compare with, and potentially adjust, future demand projections generated from SF CHAMP. For the analysis of the proposed alternatives, the AECOM team will use output from the SF-CHAMP model that will be provided by the SFCTA to determine the existing non-HOV and HOV demands along the US 101 and I-280 corridor within the project study limits. Utilizing this data from the model, lane conversion or lane add alternatives analysis will be performed for the existing conditions and will be compared against the existing conditions v/c data. For the opening year 2020 no-build and build alternatives analysis (lane conversion or lane add or hybrid) data will be extracted from SF-CHAMP model by the Authority and provided to the AECOM team. The mainline and ramp demands will be extracted from SF-CHAMP and necessary adjustments will be made by the AECOM team based on a comparison with the existing demand data. The adjusted 2020 forecast data would represent demand volume for HOV 3+, 2+ and SOV along the US 101 and I-280 corridors within the project limits. This adjusted final data would be used for the no-build and build alternatives v/c analysis..

Appendix B.5
FREEWAY ACCIDENT & INCIDENT DATA ANALYSIS METHODOLOGY

This appendix outlines the methodologies utilized for analyzing both incidents and accidents for the FCMS Phase 2 Feasibility Study. The base data sets for this analysis consisted of: 1) the Caltrans D4 TMC Activity Logs and 2) the TASAS TSAR and TABB records. The analysis methodology for each data source is listed below.

TMC Activity Log Data

The data set consisted of incidents and accidents occurring on freeways within the project study area in San Francisco and San Mateo Counties from 2013 to 2015. More than 3000 records, in total, were available for this period. The exercise described below stratified the data into smaller groups for evaluation to enable the creation of meaningful conclusions regarding how the incidents/accidents affect the study corridors of US 101 and I-280 under existing conditions. This analysis allows an assessment to be made regarding existing non-recurrent congestion in the study area, as well as how the design of future project alternatives may affect these conditions.

Year	No. of records
2015	1152
2014	1004
2013	1024

The data analysis was divided into 3 parts. Parts 1 and 2 involved the sorting of the data and part 3 reviewed the sorted records to see if there were incident hot spots, prominent incident types, prevailing time of the year or day when certain incident types occured and any other trends. The details of the methodology are presented below:

Steps 1 & 2 – Breakdown the number of records into manageable groups

- The yearly data was filtered based on the 'Lane' type affected by the incident. There were a total of 10 categories, namely: All, General Purpose (GP), 1 lane (Lane 1 thru' 5), 2 lanes (Lanes 1 & 2, Lanes 3 & 4), 3 lanes (Lanes 1-3, Lanes 2-4), Left Hand Shoulder (LHS), Right Hand Shoulder (RHS), Center Divider (CD), Off Ramp (OFR) and On Ramp (ONR). Records with '***' were not used in the analysis.
- The data was then filtered to separate the accident/collision records from the other non-collision incident records.

Step 3A – Identify non-collision incident and accident/collision locations within the study corridors

- Since the information provided included all freeways within San Francisco and San Mateo Counties, the stratified data from Steps 1 & 2 had to be further filtered to remove locations outside the study area. As such, only incidents occurring on the section between I-380 and I-80 on US 101 and the section between Geneva Avenue and the end of the freeway (5th/King) for I-280 were retained.

The table below presents the total number of incidents and accidents found to be within the study area.

	2015		2014		2013	
Lane Type	**No. of Incident Records**	**No. of Accident / Collision Records**	**No. of Incident Records**	**No. of Accident / Collision Records**	**No. of Incident Records**	**No. of Accident / Collision Records**
All	6	5	3	3	3	7
GP	5	2	7	0	10	1
1 Lane	42	47	32	2	15	5
2 Lanes	1	10	5	3	1	7
3 Lanes	3	4	2	2	2	7
LHS	10	0	8	0	11	0
RHS	214	1	229	1	232	1
CD	56	1	62	0	66	0
Off Ramp	12	1	15	0	9	0
On Ramp	6	1	22	1	6	1
Total	**355**	**72**	**385**	**12**	**355**	**29**

- The filtered data was sorted based on incident/accident locations along the freeways (separated by county), incident types and time period when the incidents/accidents occurred.
- The 3 county segments for the freeway corridors are as follows:
    1. US 101 (SF) - from the SM/SF Co. Line to the US 101/I-80 Interchange
    2. US 101 (SM) - from the US 101/I-380 Interchange to the SM/SF Co. Line
    3. I-280 (SF) - from Geneva Ave to the 5th/King freeway terminus
- As an example, the sorted data for 2015 is presented in Appendix F.

Step 3B – Analyze incident data within study area (Part 3)

- The grouped and sorted data from the previous steps was analyzed to determine if there are trends, non-collision incident and accident hot spots, prominent incident types, prevailing occurring time or other noticeable conditions. However, it was not the purpose of this analysis to identify the cause of the incidents or to determine the safety level of the study corridors. Based on the trends identified, the consultant team can qualitatively evaluate how proposed project alternatives may affect these conditions.
- Incidents/ accidents affecting the shoulders are of particular interest due to the possibility of the shoulders being used as a travel lane under the project alternatives. To better appreciate this impact, locations where the shoulders could be affected by the project alternatives were highlighted. This information will be used in the final report when the impacts of the project proposals/alternatives are discussed. The incident and accident records were summarized into different tables for presentation in this Existing Conditions Report.

TASAS Data

The data set obtained from Caltrans consisted of collision records on US 101 and I-280 within the study area for 3 years, from October 2011 to the end of September 2014. There were 3362 records for the three years in total.

Year	US 101 (SF)	US 101 (SM)	I-280	No. of records
2011-2012	531	273	284	1088
2012-2013	571	277	298	1146
2013-2014	586	292	250	1128
Total	**1688**	**842**	**832**	**3362**

The TASAS data provided a very comprehensive breakdown of the accident data, including the number of collisions occurring by month of the year, day of the week, time of day, collision factors, weather, lighting conditions, road surface, etc. However, since the purpose of reporting the collision information for the FCMS Phase 2 study is not to investigate the causes of these accidents (this will be done in subsequent phases of the project delivery process), only the following was summarized and reported in the Existing Conditions Report based on the annual records:

- Severity of Collisions (fatality, injury and property damage only)
- Persons affected (killed and injured)
- Hours of the day (peak and off peak)
- Types of Collisions (head-on, sideswipe, rear end, etc.)
- Lanes Affected

The summaries are presented in Appendix F. In particular, the hours of the day when the accidents happened, the location and the lanes affected will provide a good indication of how the design of future project alternatives may affect these conditions and overall incident management activities on the corridor.

In addition, the records were checked for consistency; items deemed as invalid were omitted from the final data set for analysis. This check removed 1 record from the 'Affected Lane' category as it reflected that an accident affected the HOV lane on US 101 in San Mateo County. There is no HOV lane in this section of the study area and as such, this is item was omitted from the analysis.

Appendix B.6
FREEWAY ACCIDENT & INCIDENT DATA SUMMARIES

Sorted Data from TMC Activity Logs – 2015 Data

Table E-1: Summary of Freeway Lanes and Locations Affected by Incidents

Highlighted locations on I-280 will be affected by shoulder lane conversion

No. of Lanes Affected	Freeway	Direction	County	Location	No. of Incidents	Total
All	US 101	NB	SF	Interch I-280	1	1
		SB	-	-	-	
	I-280	NB	SF	King St	1	5
		SB		6th St	1	
				Cesar Chavez	2	
				Interch US 101	1	
SubTotal						**6**
GP	US 101	NB	SF	3rd St	1	5
		SB	SF	Paul Ave	2	
			SM	interch I-380	2	
	I-280	NB		-	-	-
		SB		-	-	
SubTotal						**5**
1 (GP)	US 101	NB	SF	Intech I-80	5	34
				Vermont St	3	
				Cesar Chavez	3	
				Faith St POC	1	
				Interch I-280	3	
		SB	SF	Interch I-80	10	
				Vermont St	1	
				Hospital Curve	4	
				Cesar Chavez	1	
				Paul Ave	2	
				3rd St	1	
	I-280	NB	SF	6th St	1	8
				Mariposa St	2	
		SB		Cesar Chavez	4	
				Interch US 101	1	
SubTotal						**42**
2 (GP)	US 101	NB	-	-	-	-
		SB	-	-		
	I-280	NB	SF	Cesar Chavez	1	1
		SB		-	-	
SubTotal						**1**

No. of Lanes Affected	Freeway	Direction	County	Location	No. of Incidents	Total
3 (GP)	US 101	NB	-	-	-	-
		SB	-	-	-	
	I-280	NB	SF	-	-	3
		SB		Mariposa St	1	
				Cesar Chavez	2	
SubTotal						**3**
1 (LHS)	US 101	NB	SF	Interch I-280	1	2
		SB		Tunnel Ave	1	
	I-280	NB	SF	Cesar Chavez	1	8
				Interch US 101	1	
		SB		25th St	1	
				Cesar Chavez	2	
				Interch US 101	3	
SubTotal						**10**
1 (RHS)	US 101	NB	SF	Interch I-80	1	111
				Vermont St	11	
				Cesar Chavez	8	
				Alemany Blvd	2	
				Interch I-280	3	
				Silver Ave	1	
				Paul Ave	2	
				3rd St	2	
				Candlestick	5	
				Harney Way	1	
			SM	Sierra Point	2	
				Oyster Point	2	
				Grand Ave	3	
				S Airport Blvd	2	
				Intech I-380	5	
		SB	SF	Interch I-80	1	
				Vermont St	1	
				Hospital Curve	3	
				Cesar Chavez	17	
				Interch I-280	9	
				Silver Ave	8	
				Bayshore Blvd	1	
				Cow Palace	2	
				Paul Ave	4	
				3rd St	1	
				Candlestick	3	
			SM	Sierra Point	1	
				Oyster Point	5	
				Grand Ave	4	
				Produce Ave	1	
	I-280	NB	SF	King St	2	103
				6th St	4	
				Mariposa St	3	
				Cesar Chavez	4	
				Interch US 101	6	

No. of Lanes Affected	Freeway	Direction	County	Location	No. of Incidents	Total
				Alemany Blvd	8	
				San Jose Ave	4	
				Monterey Blvd	2	
				Ocean Ave	3	
				Geneva Ave	11	
		SB		King St	1	
				6th St	4	
				Mariposa St	6	
				Cesar Chavez	9	
				Interch US 101	13	
				Alemany Blvd	10	
				Mission St	2	
				Monterey Blvd	6	
				Ocean Ave	4	
				Geneva Ave	1	
SubTotal						**214**
Center Divider	US 101	NB	SF	Vermont St	2	30
				Cesar Chavez	2	
				Alemany Blvd	1	
				Interch I-280	1	
				Silver Ave	1	
				Candlestick	2	
			SM	Oyster Point	1	
				Produce Ave	1	
				S Airport Blvd	1	
		SB	SF	Hospital Curve	1	
				Cesar Chavez	5	
				Interch I-280	3	
				Silver Ave	3	
				Paul Ave	1	
				Bayshore Blvd	1	
			SM	Oyster Point	2	
				Grand Ave	1	
				Airport Blvd	1	
	I-280	NB	SF	6th St	1	26
				Mariposa St	1	
				Interch US 101	1	
				Alemany Blvd	1	
				Ocean Ave	1	
				Geneva Ave	6	
		SB		King St	2	
				18th St	1	
				Mariposa St	2	
				Cesar Chavez	3	
				Interch US 101	3	
				San Jose Ave	1	
				Monterey Blvd	1	
				Ocean Ave	2	
SubTotal						**56**

No. of Lanes Affected	Freeway	Direction	County	Location	No. of Incidents	Total
Off Ramp	US 101	NB	SF	Vermont St	1	8
				Silver Ave	1	
			SM	Grand Ave	1	
		SB	SF	Cesar Chavez	4	
				Bayshore Blvd	1	
	I-280	NB	SF	King St	1	4
				6th St	1	
				Cesar Chavez	1	
		SB		Ocean Ave	1	
SubTotal						**12**
On Ramp	US 101	NB	SF	3rd St	1	4
		SB		Cesar Chavez	2	
				Alemany Blvd	1	
	I-280	NB		Monterey Blvd	1	2
		SB		Cesar Chavez	1	
SubTotal						**6**
Grand Total						**355**

Table E-2: Summary of Freeway Lanes and Locations Affected by Accidents

Highlighted locations on I-280 will be affected by shoulder lane conversion

No. of Lanes Affected	Freeway	Direction	County	Location	No. of Accidents	Total
All	US 101	NB	SF	Interch I-280	1	3
		SB		Interch I-80	1	
				Silver Ave	1	
	I-280	NB		Interch US 101	1	2
				Geneva Ave	1	
SubTotal						**5**
GP	US 101	NB	SF	Interch I-80	1	2
		SB		Interch I-280	1	
SubTotal						**2**
1 (GP)	US 101	NB	SF	Interch I-80	5	41
				Vermont	3	
				Hospital Curve	1	
				Cesar Chavez	4	
				Interch I-280	6	
		SB		Interch I-80	10	
				Vermont	1	
				Hospital Curve	1	
				23rd St	1	
				Cesar Chavez	6	
				Interch I-280	1	
				Silver Ave	1	
				Cow Palace	1	
	I-280	NB		6th St	1	6
				Interch US 101	2	
		SB		Mariposa	1	

No. of Lanes Affected	Freeway	Direction	County	Location	No. of Accidents	Total
				Interch US 101	1	
				Mission	1	
SubTotal						**47**
2 (GP)	US 101	NB	SF	Alemany Blvd	1	7
				3rd St	2	
		SB		Cesar Chavez	3	
				Interch I-280	1	
	I-280	NB		Cesar Chavez	2	3
		SB		Ocean Ave	1	
SubTotal						**10**
3 (GP)	US 101	NB	SF	Vermont	1	4
				Interch I-280	1	
				Silver Ave	1	
		SB		Cesar Chavez	1	
SubTotal						**4**
1 (LHS)	US 101	-	-	-	-	-
	I-280	-	-	-	-	-
SubTotal						**0**
1 (RHS)	US 101	NB	SF	Interch I-280	1	1
	I-280	-	-	-	-	-
SubTotal						**1**
Center Divider	US 101	NB	SF	Interch I-280	1	1
	I-280	-	-	-	-	-
SubTotal						**1**
Off Ramp	US 101	-	-	-	-	-
	I-280	NB	SF	Cesar Chavez	1	1
SubTotal						**1**
On Ramp	US 101	SB	SF	Bayshore	1	1
	I-280	-		-	-	-
SubTotal						**1**
Grand Total						**72**

Table E-3: Summary of Incident Types Affecting Freeway Lanes

No. of Lanes Affected	Types of Incidents	No. of Incidents	Total
All	Flooding	4	6
	Car Fire	1	
	Blocked Veh	1	
GP	Debris / Objects	5	5
1 (GP)	Stalled Veh	24	42
	Flooding	8	
	Car Fire	2	
	Debris / Objects	2	
	Pothole	3	
	Others	3	
2 (GP)	Flooding	1	1
3 (GP)	Flooding	3	3
1 (LHS)	Debris / Objects	10	10
1 (RHS)	Debris / Objects	205	214
	Car Fire	2	
	Animal	3	
	Flooding	1	
	Pothole	1	
	Others	2	
Center Divider	Animal	3	56
	Debris / Objects	53	
Off Ramp	Debris / Objects	8	12
	Others	4	
On Ramp	Car Fire	1	6
	Flooding	1	
	Debris / Objects	3	
	Others	1	
Grand Total			**355**

Table E-4: Summary of Accident Types Affecting Freeway Lanes

No. of Lanes Affected	Types of Accidents	No. of Accidents	Total
All	Traffic Collision	1	5
	Overturn Vehicle	1	
	Involved Ped	1	
	Others	2	
GP	Traffic Collision	2	2
1 (GP)	Traffic Collision	46	47
	Overturn Vehicle	1	
2 (GP)	Traffic Collision	8	10
	Others	2	
3 (GP)	Traffic Collision	3	4
	Others	1	
1 (LHS)	-	-	-
1 (RHS)	Traffic Collision	1	1
Center Divider	Traffic Collision	1	1
Off Ramp	Traffic Collision	1	1
On Ramp	Others	1	1
Grand Total			**72**

Table E-5: Summary of Incident Time

No. of Lanes Affected	Time of Incidents	No. of Incidents	Total
All	Peak	1	6
	Non Peak	5	
GP	Peak	1	5
	Non Peak	4	
1 (GP)	Peak	12	42
	Non Peak	30	
2 (GP)	Peak	0	1
	Non Peak	1	
3 (GP)	Peak	1	3
	Non Peak	2	
1 (LHS)	Peak	6	10
	Non Peak	4	
1 (RHS)	Peak	63	214
	Non Peak	151	
Center Divider	Peak	19	56
	Non Peak	37	
Off Ramp	Peak	4	12
	Non Peak	8	
On Ramp	Peak	3	6
	Non Peak	3	
Grand Total			**355**

Table E-6: Summary of Accident Time

No. of Lanes Affected	Time of Accidents	No. of Accidents	Total
All	Peak	2	5
	Non Peak	3	
GP	Peak	1	2
	Non Peak	1	
1 (GP)	Peak	28	47
	Non Peak	19	
2 (GP)	Peak	1	10
	Non Peak	9	
3 (GP)	Peak	1	4
	Non Peak	3	
1 (LHS)	Peak	-	0
	Non Peak	-	
1 (RHS)	Peak	1	1
	Non Peak	0	
Center Divider	Peak	0	1
	Non Peak	1	
Off Ramp	Peak	0	1
	Non Peak	1	
On Ramp	Peak	0	1
	Non Peak	1	
Grand Total			**72**

Summarized Data from TASAS – Oct 2011 – Sept 2014 Data

Table E-7: Accident Severity and Persons Involved

Freeway	Year	Total Accident	Severity			Persons Involved	
			Fatal	Injury	PDO	Fatal	Injured
US 101 (SF)	2011-2012	531	3	181	347	3	253
	2012-2013	571	0	164	407	0	242
	2013-2014	586	1	186	399	1	242
	Total	1688	4	531	1153	4	737
US 101 (SM)	2011-2012	273	1	102	170	1	149
	2012-2013	277	1	101	175	1	140
	2013-2014	292	1	137	154	1	200
	Total	842	3	340	499	3	489
I-280	2011-2012	284	1	133	150	1	196
	2012-2013	298	1	106	191	1	165
	2013-2014	250	1	100	149	1	147
	Total	832	3	339	490	3	508

PDO - Property Damage Only

Table E-8: Collision Type

Freeway	Year	COLLISION TYPE									
		Head On	Side-swipe	Rear End	Broad-side	Hit Object	Over-turn	Auto -Ped	Others	Not Stated	INVALID CODES
US 101 (SF)	2011-2012	2	117	318	8	72	4	3	4	3	0
	2012-2013	3	137	346	7	61	7	1	4	5	0
	2013-2014	1	144	360	6	55	11	1	3	5	0
	TOTAL	6	398	1024	21	188	22	5	11	13	0
US 101 (SM)	2011-2012	0	63	125	6	64	9	0	6	0	0
	2012-2013	4	60	134	5	62	7	1	2	2	0
	2013-2014	4	74	116	7	75	12	0	2	2	0
	TOTAL	8	197	375	18	201	28	1	10	4	0
I-280	2011-2012	2	56	142	7	63	5	4	4	1	0
	2012-2013	2	65	140	3	80	2	1	4	1	0
	2013-2014	1	55	130	8	44	8	2	0	2	0
	TOTAL	5	176	412	18	187	15	7	8	4	0

Table E-9: Freeway Direction of Accident and Accident Time

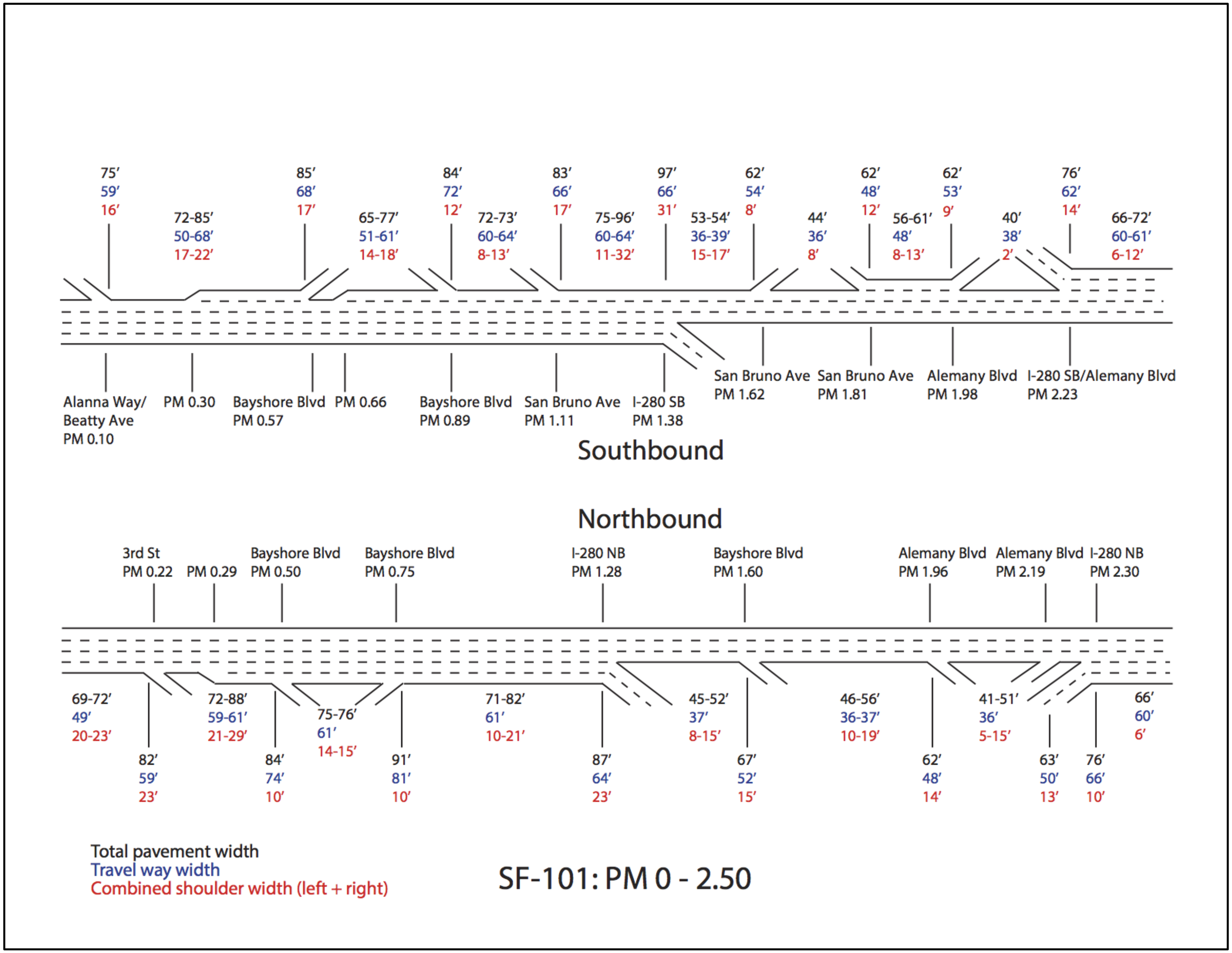
FREEWAY	YEAR	DIRECTION		ACCIDENTS TIME	
		NB	SB	PEAK HOURS	NON-PEAK HOURS
US 101 (SF)	2011-2012	278	253	273	258
	2012-2013	296	275	305	266
	2013-2014	318	268	313	273
	TOTAL	892	796	891	797
US 101 (SM)	2011-2012	128	145	150	123
	2012-2013	127	150	131	146
	2013-2014	158	134	144	148
	TOTAL	413	429	425	417
I-280	2011-2012	132	152	162	122
	2012-2013	141	157	169	129
	2013-2014	133	117	140	110
	TOTAL	406	426	471	361

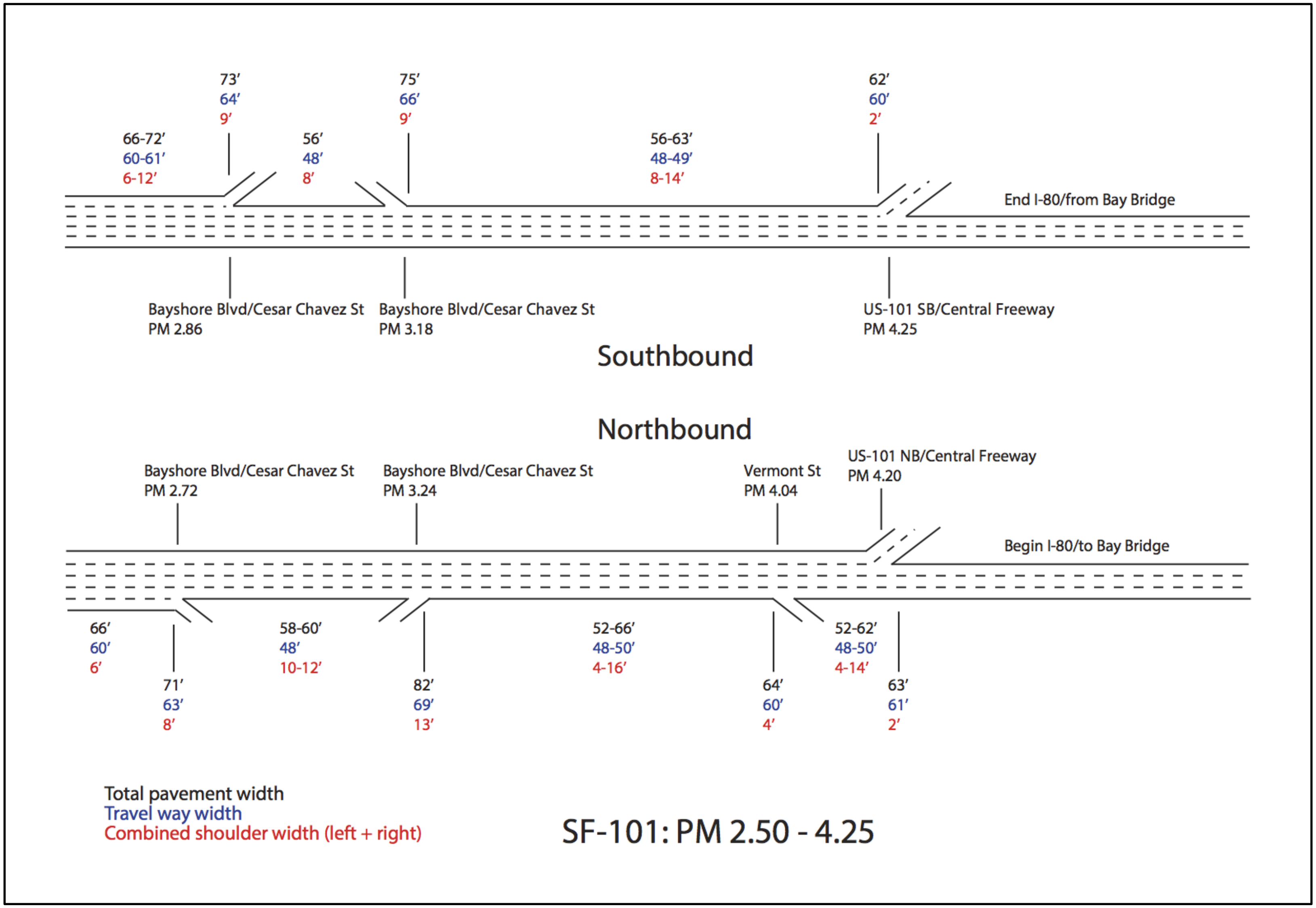
Table E-10: Freeway Lanes and Areas Affected by Accidents

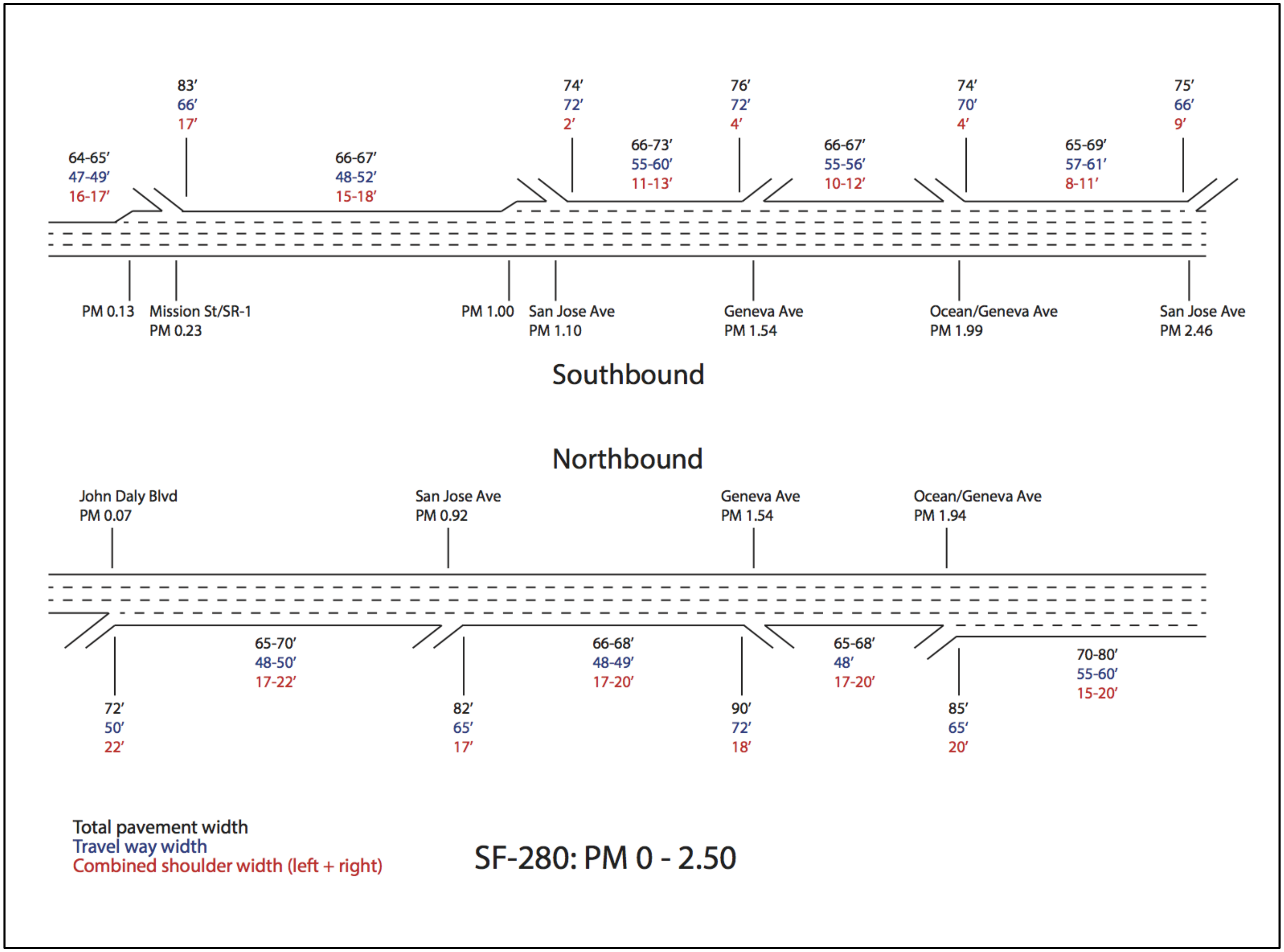
Freeway	Year	AFFECTED LANES OR FREEWAY AREA														
		Beyond Median or Stripe-Left	Beyond Shoulder Drivers Left	Left Shoulder Area	Left Lane	Interior Lanes	Right Lane	Right Shoulder Area	Beyond Shoulder Drivers Right	Gore Area	Others	HOV Lane(s) [2]	HOV Lanes Buffer Area	Not Stated	Does Not Apply	Invalid Codes
US 101 (SF)	2011-2012	4	37	0	140	256	130	4	23	0	7	0	0	0	133	0
	2012-2013	1	31	1	154	294	141	4	20	0	6	0	0	0	145	0
	2013-2014	0	23	2	213	288	111	5	19	7	3	0	0	0	174	0
	TOTAL[1]	5	91	3	507	838	382	13	62	7	16	0	0	0	452	0
US 101 (SM)	2011-2012	0	24	2	69	127	60	1	26	0	1	0	0	0	77	0
	2012-2013	0	32	2	72	105	68	2	22	1	4	1	0	0	55	0
	2013-2014	1	34	0	64	119	73	2	37	1	5	0	0	0	61	0
	TOTAL [1]	1	90	4	205	351	201	5	85	2	10	1	0	0	193	0
I-280 (SF)	2011-2012	0	33	0	61	91	98	1	31	0	2	0	0	0	72	0
	2012-2013	2	43	0	50	100	104	3	30	0	5	0	0	0	71	0
	2013-2014	1	22	1	50	88	98	2	18	1	4	0	0	0	53	0
	TOTAL [1]	3	98	1	161	279	300	6	79	1	11	0	0	0	196	0

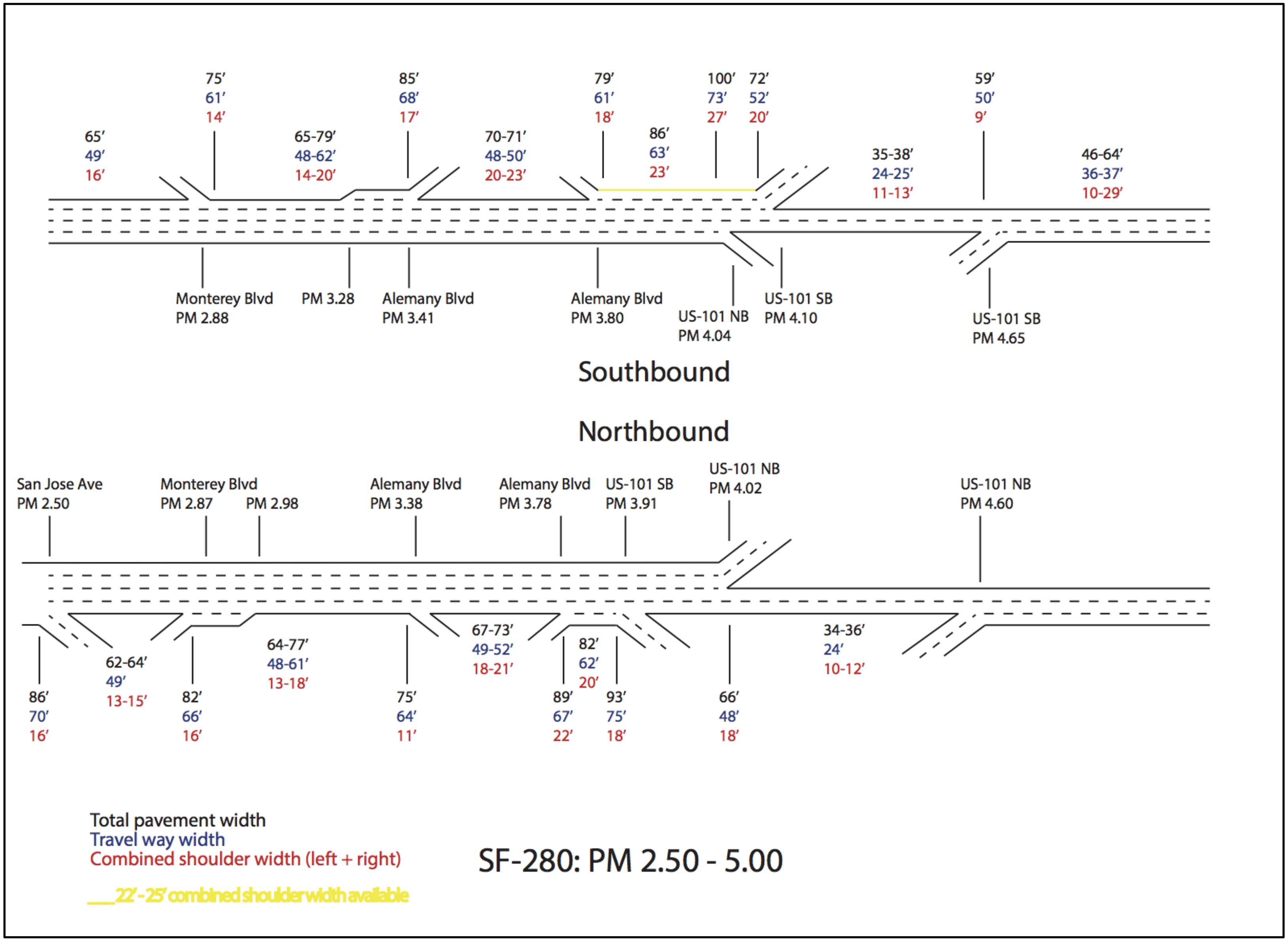
Note:
1. *More than one lane type or area may be affected by each accident. As such, the total is higher than total number of accidents.*
2. *There is no HOV lane in the study area.*

Appendix B.7
FREEWAY LANE CONFIGURATIONS

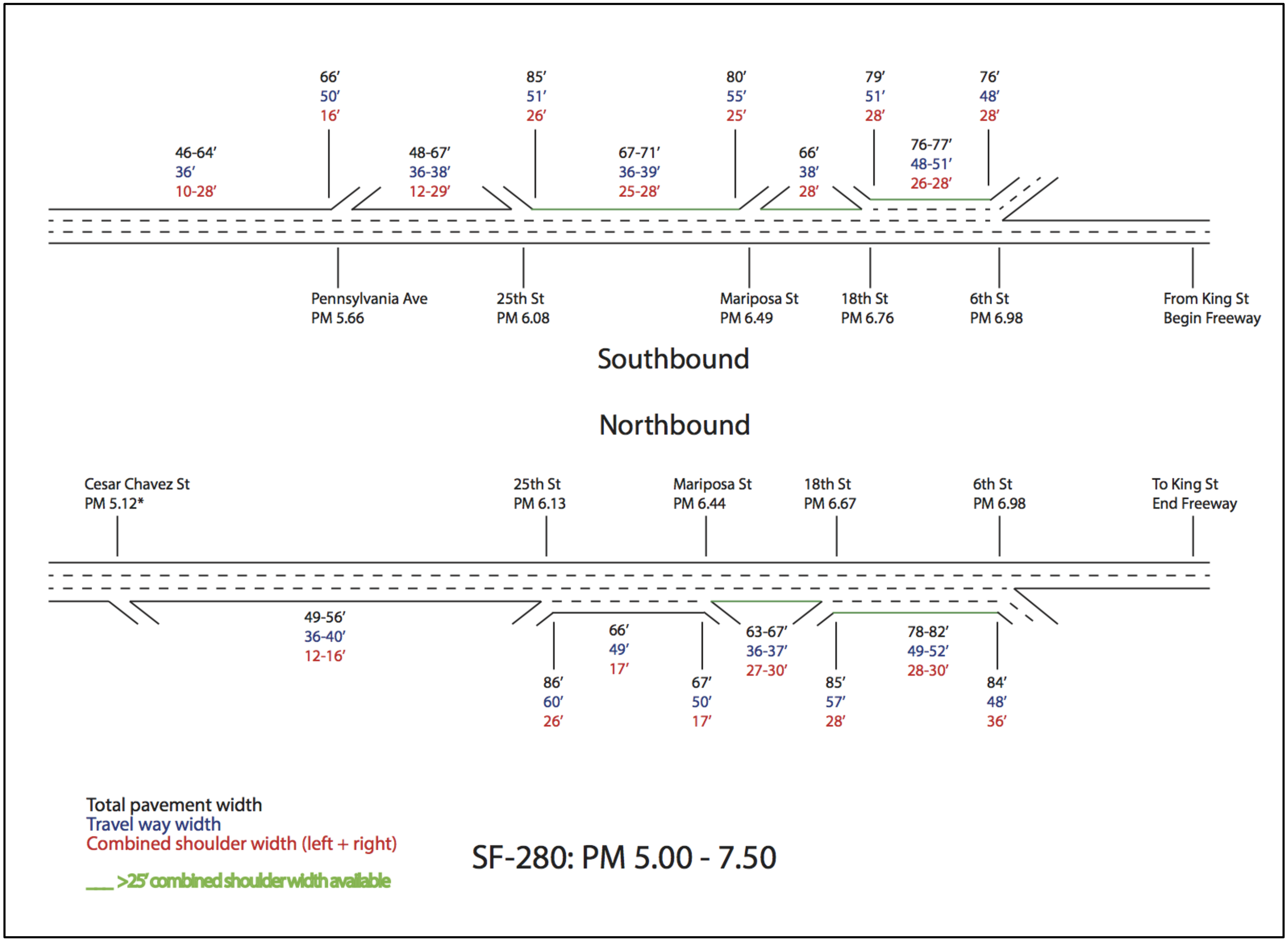

75′
59′
16′
72-85′
50-68′
17-22′
85′
68′
17′
65-77′
51-61′
14-18′
84′
72′
12′
72-73′
60-64′
8-13′
83′
66′
17′
75-96′
60-64′
11-32′
97′
66′
31′
53-54′
36-39′
15-17′
62′
54′
8′
44′
36′
8′
62′
48′
12′
56-61′
48′
8-13′
62′
53′
9′
40′
38′
2′
76′
62′
14′
66-72′
60-61′
6-12′
Alanna Way/
Beatty Ave
PM 0.10
PM 0.30
Bayshore Blvd
PM 0.57
PM 0.66
Bayshore Blvd
PM 0.89
San Bruno Ave
PM 1.11
I-280 SB
PM 1.38
San Bruno Ave
PM 1.62
San Bruno Ave
PM 1.81
Alemany Blvd
PM 1.98
I-280 SB/Alemany Blvd
PM 2.23
Southbound
Northbound
3rd St
PM 0.22
PM 0.29
Bayshore Blvd
PM 0.50
Bayshore Blvd
PM 0.75
I-280 NB
PM 1.28
Bayshore Blvd
PM 1.60
Alemany Blvd
PM 1.96
Alemany Blvd
PM 2.19
I-280 NB
PM 2.30
69-72′
49′
20-23′
82′
59′
23′
72-88′
59-61′
21-29′
84′
74′
10′
75-76′
61′
14-15′
91′
81′
10′
71-82′
61′
10-21′
87′
64′
23′
45-52′
37′
8-15′
67′
52′
15′
46-56′
36-37′
10-19′
62′
48′
14′
41-51′
36′
5-15′
63′
50′
13′
76′
66′
10′
66′
60′
6′
Total pavement width
Travel way width
Combined shoulder width (left + right)
SF-101: PM 0 - 2.50


73′
64′
9′
75′
66′
9′
62′
60′
2′
66-72′
60-61′
6-12′
56′
48′
8′
56-63′
48-49′
8-14′
End I-80/from Bay Bridge
Bayshore Blvd/Cesar Chavez St
PM 2.86
Bayshore Blvd/Cesar Chavez St
PM 3.18
US-101 SB/Central Freeway
PM 4.25
Southbound
Northbound
Bayshore Blvd/Cesar Chavez St
PM 2.72
Bayshore Blvd/Cesar Chavez St
PM 3.24
Vermont St
PM 4.04
US-101 NB/Central Freeway
PM 4.20
Begin I-80/to Bay Bridge
66′
60′
6′
58-60′
48′
10-12′
52-66′
48-50′
4-16′
52-62′
48-50′
4-14′
71′
63′
8′
82′
69′
13′
64′
60′
4′
63′
61′
2′
Total pavement width
Travel way width
Combined shoulder width (left + right)
SF-101: PM 2.50 - 4.25


83'
66'
17'
74'
72'
2'
76'
72'
4'
74'
70'
4'
75'
66'
9'
64-65'
47-49'
16-17'
66-67'
48-52'
15-18'
66-73'
55-60'
11-13'
66-67'
55-56'
10-12'
65-69'
57-61'
8-11'
PM 0.13
Mission St/SR-1
PM 0.23
PM 1.00
San Jose Ave
PM 1.10
Geneva Ave
PM 1.54
Ocean/Geneva Ave
PM 1.99
San Jose Ave
PM 2.46
Southbound
Northbound
John Daly Blvd
PM 0.07
San Jose Ave
PM 0.92
Geneva Ave
PM 1.54
Ocean/Geneva Ave
PM 1.94
65-70'
48-50'
17-22'
66-68'
48-49'
17-20'
65-68'
48'
17-20'
70-80'
55-60'
15-20'
72'
50'
22'
82'
65'
17'
90'
72'
18'
85'
65'
20'
Total pavement width
Travel way width
Combined shoulder width (left + right)
SF-280: PM 0 - 2.50



65' 49' 16'
75' 61' 14'
65-79' 48-62' 14-20'
85' 68' 17'
70-71' 48-50' 20-23'
79' 61' 18'
86' 63' 23'
100' 73' 27'
72' 52' 20'
35-38' 24-25' 11-13'
59' 50' 9'
46-64' 36-37' 10-29'
Monterey Blvd PM 2.88
PM 3.28
Alemany Blvd PM 3.41
Alemany Blvd PM 3.80
US-101 NB PM 4.04
US-101 SB PM 4.10
US-101 SB PM 4.65
Southbound
Northbound
San Jose Ave PM 2.50
Monterey Blvd PM 2.87
PM 2.98
Alemany Blvd PM 3.38
Alemany Blvd PM 3.78
US-101 SB PM 3.91
US-101 NB PM 4.02
US-101 NB PM 4.60
86' 70' 16'
62-64' 49' 13-15'
82' 66' 16'
64-77' 48-61' 13-18'
75' 64' 11'
67-73' 49-52' 18-21'
89' 67' 22'
82' 62' 20'
93' 75' 18'
66' 48' 18'
34-36' 24' 10-12'
Total pavement width
Travel way width
Combined shoulder width (left + right)
___22'-25' combined shoulder width available
SF-280: PM 2.50 - 5.00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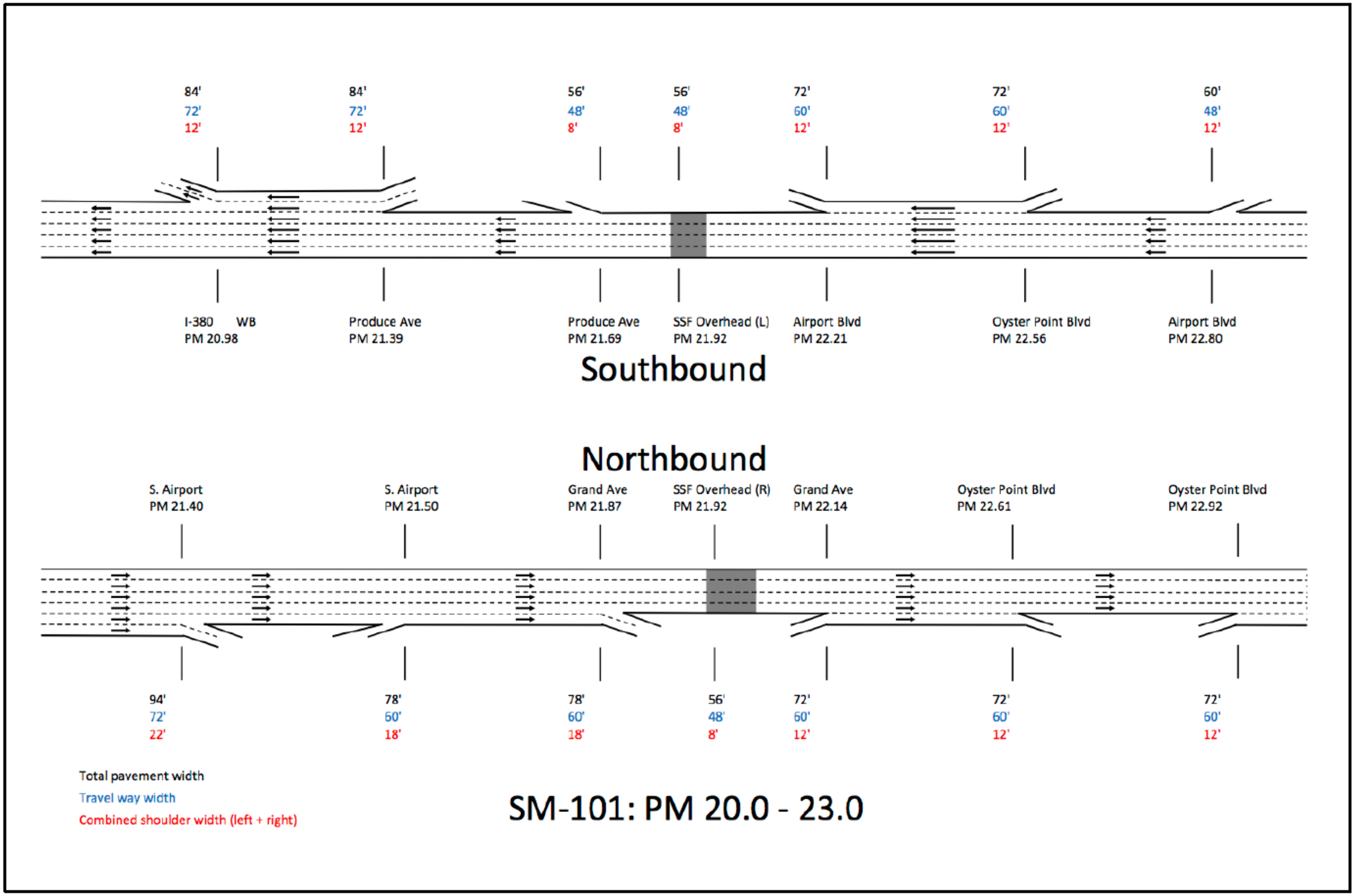
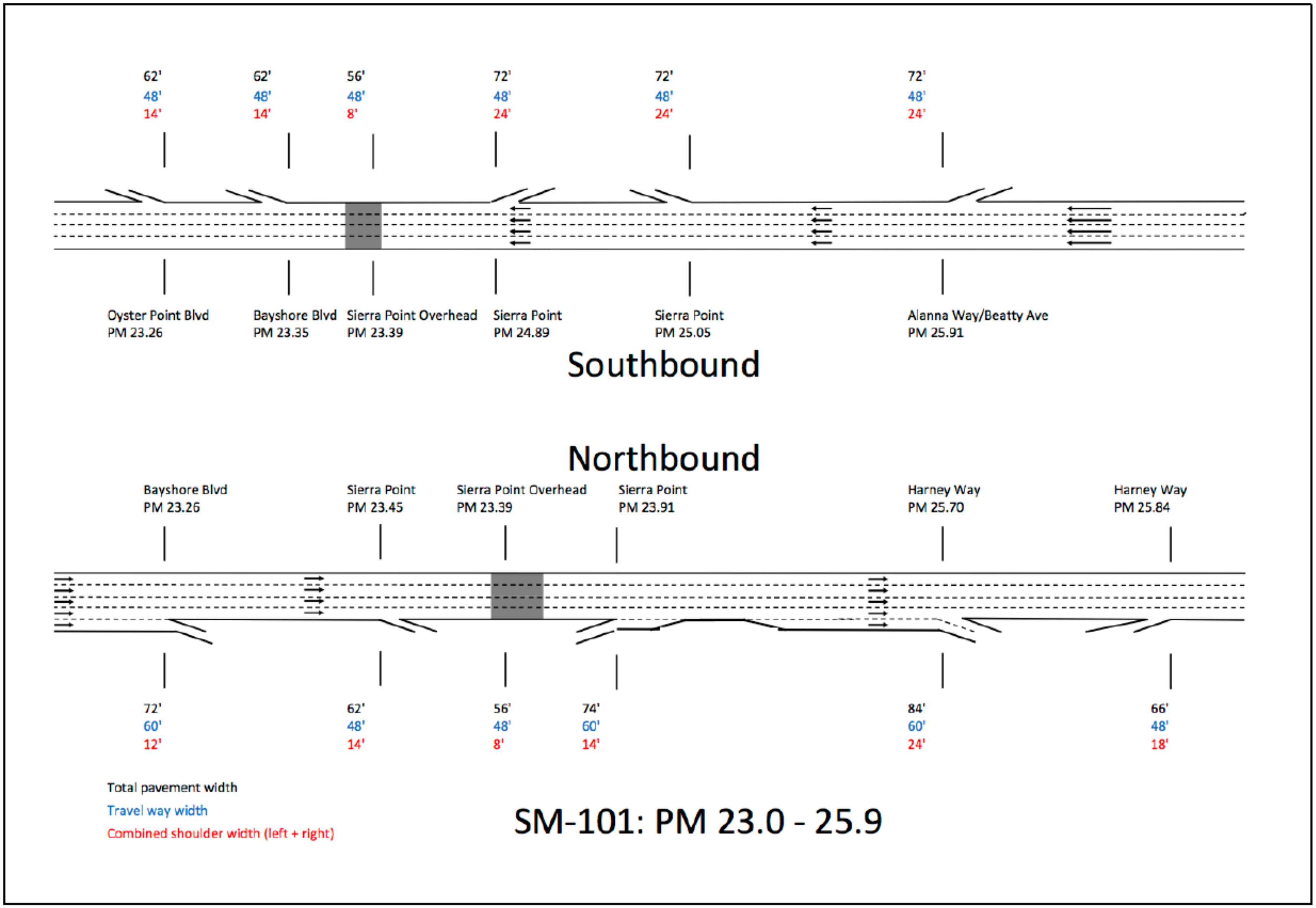
50'
16'
85'
51'
26'
80'
55'
25'
79'
51'
28'
76'
48'
28'
46-64'
36'
10-28'
48-67'
36-38'
12-29'
67-71'
36-39'
25-28'
66'
38'
28'
76-77'
48-51'
26-28'
Pennsylvania Ave
PM 5.66
25th St
PM 6.08
Mariposa St
PM 6.49
18th St
PM 6.76
6th St
PM 6.98
From King St
Begin Freeway
Southbound
Northbound
Cesar Chavez St
PM 5.12*
25th St
PM 6.13
Mariposa St
PM 6.44
18th St
PM 6.67
6th St
PM 6.98
To King St
End Freeway
49-56'
36-40'
12-16'
66'
49'
17'
63-67'
36-37'
27-30'
78-82'
49-52'
28-30'
86'
60'
26'
67'
50'
17'
85'
57'
28'
84'
48'
36'
Total pavement width
Travel way width
Combined shoulder width (left + right)
>25' combined shoulder width available
SF-280: PM 5.00 - 7.50


84'
72'
12'
84'
72'
12'
56'
48'
8'
56'
48'
8'
72'
60'
12'
72'
60'
12'
60'
48'
12'
I-380 WB
PM 20.98
Produce Ave
PM 21.39
Produce Ave
PM 21.69
SSF Overhead (L)
PM 21.92
Airport Blvd
PM 22.21
Oyster Point Blvd
PM 22.56
Airport Blvd
PM 22.80
Southbound
Northbound
S. Airport
PM 21.40
S. Airport
PM 21.50
Grand Ave
PM 21.87
SSF Overhead (R)
PM 21.92
Grand Ave
PM 22.14
Oyster Point Blvd
PM 22.61
Oyster Point Blvd
PM 22.92
94'
72'
22'
78'
60'
18'
78'
60'
18'
56'
48'
8'
72'
60'
12'
72'
60'
12'
72'
60'
12'
Total pavement width
Travel way width
Combined shoulder width (left + right)
SM-101: PM 20.0 - 23.0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48'
14'
62'
48'
14'
56'
48'
8'
72'
48'
24'
72'
48'
24'
72'
48'
24'
Oyster Point Blvd
PM 23.26
Bayshore Blvd
PM 23.35
Sierra Point Overhead
PM 23.39
Sierra Point
PM 24.89
Sierra Point
PM 25.05
Alanna Way/Beatty Ave
PM 25.91
Southbound
Northbound
Bayshore Blvd
PM 23.26
Sierra Point
PM 23.45
Sierra Point Overhead
PM 23.39
Sierra Point
PM 23.91
Harney Way
PM 25.70
Harney Way
PM 25.84
72'
60'
12'
62'
48'
14'
56'
48'
8'
74'
60'
14'
84'
60'
24'
66'
48'
18'
Total pavement width
Travel way width
Combined shoulder width (left + right)
SM-101: PM 23.0 - 25.9

Appendix B.8
FREEWAY ITS INFRASTRUCTURE

Table H-1 CHANGEABLE MESSAGE SIGNS

Maint ID	County	Route	Dir	Post Mile	Location
CM062	SF	080	E	4.5	E80 NOF 8TH ST
CM041	SF	080	W	4.73	W80 AT 5TH ST
CM063	SF	080	W	5.7	W80 AT SFOBB ANCHORAGE
CM079	SF	101	N	0.17	N101 NOF CANDLESTICK OFR
CM028	SF	101	S	3.2	S101 NOF ARMY ST
CM042	SF	101	N	3.53	N101 NOF 23RD ST OC
CM043	SF	101	S	5.14	S101 AT S VAN NESS OR
CM011	SM	101	S	24.77	S101 NOF SIERRA POINT
CM027	SF	280	S	0.56	S280 NOF JOHN DALY BL
CM080	SF	280	N	3.12	N280 MISSION ST OC
CM005	SF	280	S	5.04	S280 NOF 280/101 SEP
CM047	SF	280	S	7.1	WB BRANNAN ST 280 OR
CM048	SF	280	S	7.1	S280 AT 6TH ST OR
CM046	SF	280	S	7.11	EB BRANNAN ST 280 OR
CM049	SF	280	S	7.3	S280 AT KING ST OR

Source: Caltrans District 4, October 2013

Table H-2 CLOSED CIRCUIT TELEVISION CAMERAS

MaintID	County	Route	Dir	Post Mile	Location
TV304	SF	80	E	3.95	E80 AT JCT-101
TV316	SF	80	E	4.38	E80 AT 6TH ST
TVD01	SF	80	W	5.65	W80 AT FREMONT ST
TVD22	SF	80	E	5.92	EB 80 AT LOWER DECK-STERLING ON
TV302	SF	101	S	4.1	S101 AT 17TH ST
TV305	SF	101	N	0.16	N101 JNO 3COM PARK
TV311	SF	101	S	3.8	S101 AT HOSPITAL CURVE
TV312	SF	101	S	2.91	S101 AT CESAR CHAVEZ
TV313	SF	101	N	3.36	N101 AT 23RD ST
TV379	SF	101	S	0.56	S101 AT 3RD/BAYSHORE
TV380	SF	101	S	1.2	S101 AT 280 SPLIT
TV401	SM	101	S	22	S101 ON AIRPORT FLYOVER STRUCTURE
TV403	SM	101	N	25.02	N101 JNO LAGOON WAY
TV407	SM	101	S	20.98	S101 JNO 380 IC
TV306	SF	280	S	3.11	S280 AT MISSION ST
TV309	SF	280	S	5.62	S280 AT CESAR CHAVEZ
TV314	SF	280	N	6.06	N280 AT INDIANA ST
TV315	SF	280	N	6.52	N280 AT MARIPOSA ST
TV317	SF	280	N	7.01	N280 AT 6TH ST OFR
TV318	SF	280	N	1.77	N280 AT OCEAN AV
TV319	SF	280	S	2.05	S280 AT HAVELOCK ST POC
TV320	SF	280	S	2.62	S280 ON MONTEREY BL
TV325	SF	280	N	5.03	N280 JSO CESAR CHAVEZ
TV326	SF	280	S	5.04	S280 JSO CESAR CHAVEZ
TV327	SF	280	S	0.15	S280 AT JOHN DALY

Source: Caltrans District 4, October 2013

Table H-3 ROADWAY DETECTORS

Fwy	Dir	County	CA PM	Abs PM	ID	Location
101	N	San Mateo	20.96	423.15	400316	WB 380/S Airport Blvd
101	N	San Mateo	21.48	423.67	400503	S. Airport Blvd rm-n-hook
101	N	San Mateo	21.76	423.95	400540	S Airport Blvd off-s-diag
101	N	San Mateo	22.11	424.3	405843	Grand Ave rm-n-fly
101	N	San Mateo	22.56	424.75	408093	Oyster Point Blvd rm-s-fly
101	N	San Mateo	22.7	424.89	402390	4A5324 LOC 86
101	N	San Mateo	22.92	425.11	401448	Oyster Point Blvd rm-n
101	N	San Mateo	23.1	425.29	402391	4A5324 loc 87
101	N	San Mateo	23.53	425.72	400497	S of Sierra Pt Prkwy/Marina
101	N	San Mateo	23.88	426.07	405841	S Sierra Point Prkwy rm-n-diag
101	N	San Mateo	24.77	426.96	404520	S of Sierra Point Pkwy/Lagoon
101	N	San Mateo	24.81	427	400183	2400' N of Sierra Point Prkwy
101	N	San Mateo	24.9	427.09	401469	Sierra Point Parkway rm-s-diag
101	N	San Mateo	25.55	427.74	401472	Sierra Pt Parkway & Lagoon Wy
101	N	San Mateo	25.78	427.97	405838	Harney Way rm-n-loop
101	N	San Mateo	25.98	428.17	400260	oppo Harney Way rm-s-diag
101	S	San Mateo	20.78	423	400763	SFIA/San Bruno Ave
101	S	San Mateo	20.97	423.19	400886	WB 380 conn-s-diag
101	S	San Mateo	21.43	423.65	406032	Produce Ave rm-s-diag
101	S	San Mateo	21.49	423.71	400766	oppo S. Airport Blvd rm-n-hook
101	S	San Mateo	21.78	424	401523	S Airport Blvd off-s-diag
101	S	San Mateo	22.58	424.8	408101	Oyster Point Blvd rm-s-fly
101	S	San Mateo	22.93	425.15	401451	Oyster Point Blvd rm-n-diag
101	S	San Mateo	22.96	425.18	408098	Bayshore Blvd rm-s-diag/hook
101	S	San Mateo	23.1	425.32	402392	4A5324 loc 87
101	S	San Mateo	23.53	425.75	400781	S of Sierra Pt Prkwy/Marina
101	S	San Mateo	23.86	426.08	405900	S Sierra Point Prkwy rm-n-diag
101	S	San Mateo	24.77	426.99	404575	S of Sierra Point Pkwy/Lagoon
101	S	San Mateo	24.81	427.03	400744	2400' N of Sierra Point Prkwy
101	S	San Mateo	24.88	427.1	401462	Sierra Point Pkwy rm-s-hook
101	S	San Mateo	25.55	427.77	401501	Sierra Pt Parkway & Lagoon Wy
101	S	San Mateo	25.77	427.99	405870	oppo Harney Way rm-n-loop
101	N	San Francisco	0.17	428.46	404528	Blanken Ave
101	N	San Francisco	0.65	428.94	401795	3rd St off-n-diag
101	N	San Francisco	1.1	429.39	401358	Paul Ave off-s-loop

Fwy	Dir	County	CA PM	Abs PM	ID	Location
101	N	San Francisco	1.4	429.69	400255	BACON ST NEAR SAN BRUNO AVE
101	N	San Francisco	1.9	430.19	401934	On Bayshore Blvd
101	N	San Francisco	2.53	430.82	401277	Faith S
101	N	San Francisco	3.3	431.59	403132	Cesar Chavez St on
101	N	San Francisco	3.3	431.59	400868	25th St POC
101	N	San Francisco	3.53	431.82	401409	Vermont St
101	N	San Francisco	3.8	432.09	401516	20th Street - Hospital Curve
101	N	San Francisco	R5.14	433.43	406871	13th / South Van Ness
101	N	San Francisco	R5.18	433.47	401819	Valencia St
101	S	San Francisco	0.17	428.5	404569	Blanken Ave
101	S	San Francisco	0.65	428.98	401454	3rd St. off ramp
101	S	San Francisco	1.1	429.43	401357	Paul Ave off-s-loop
101	S	San Francisco	1.1	429.43	403092	Paul Ave off
101	S	San Francisco	1.9	430.23	401935	On Bayshore Blvd
101	S	San Francisco	2.61	430.94	401285	Faith St
101	S	San Francisco	3.3	431.63	400043	25th St POC
101	S	San Francisco	3.3	431.63	403131	Cesar Chavez St off
101	S	San Francisco	3.53	431.86	401410	Vermont St
101	S	San Francisco	3.8	432.13	401408	20TH STREET - HOSPITAL CURVE
101	S	San Francisco	R5.14	434.14	401405	13th / South Van Ness
101	S	San Francisco	R5.18	434.18	401820	Valencia St
280	N	San Francisco	1.52	51.48	404618	Ocean Ave on-n-diag
280	N	San Francisco	2.05	52.01	400156	Havelock St
280	N	San Francisco	2.64	52.6	400676	S of Monterey Blvd
280	N	San Francisco	3.11	53.07	401486	Mission St OC
280	N	San Francisco	3.44	53.4	400575	ST MARY'S PLAYGROUND POC
280	N	San Francisco	3.87	53.83	400322	Alemany Blvd
280	N	San Francisco	R6.52	56.48	400573	18 TH ST / PENNSYLVANIA
280	S	San Francisco	1.52	51.49	404648	oppo Ocean Ave on-n-diag
280	S	San Francisco	1.65	51.62	400746	Geneva Ave on-s-diag
280	S	San Francisco	2.05	52.02	400397	HAVELOCK ST
280	S	San Francisco	2.64	52.61	400318	SOUTH OF MONTEREY
280	S	San Francisco	3.11	53.08	401470	MISSION ST OC
280	S	San Francisco	3.44	53.41	400552	St. Mary's Playground POC
280	S	San Francisco	3.87	53.84	401018	ALEMANY BLVD
280	S	San Francisco	6.52	56.49	400231	18th St / Pennsylvania

Appendix B.9
OTHER PLANNED PROJECTS

There are several planned and proposed projects that fall within the study's time horizon, including adjoining agency projects, which would most affect or be affected by management strategies for San Francisco freeways. A summary of these projects is provided in Table I-1 below. In addition to the projects detailed below, transit and transportation improvements serving Park Merced that will affect the Muni M-Ocean View line and 19th Avenue are in the early stages of concept development.

Table I-1 Planned Projects

Route	Post Mile	Project Name	Description	Fiscal Year
I-80	N/A	SFMTA Central Subway Project in the City and County of San Francisco at 4th Street	Construct tunnel and open portal tunnel under I-80	13/14
I-280	R0/R0	SF-101/280 Replace Rails 10 Bridges	Upgrade bridge rails at US 101/I-280 separation on the following ten bridges: BR 34-0131L, BR 34-0132R, BR 34-0133R, BR 34-0134G, BR 34-0135G, BR34-0136G, BR 34-0046 (PORTION), BR 34-0070, BR 34-0070E, BR 34-0070H	14/15
I-80	5.9 / 7.7	Drainage Scuppers and Grating Shields	Replace grating shields, ladders, platforms, and grease lines in San Francisco on I-80 at the San Francisco-Oakland Bay Bridge	
I-80	4.9 / 5.9	Bus Ramps and FMT Street Modification	New bus ramps to/from the new terminal to I-80 and bus storage facility in San Francisco on I-80 from 2nd Street to Essex Street	14/15
US 101	3.4 / 3.4	SF-101 Slope Repair	Reconstruct slope with RSP in San Francisco County on US 101 near 23rd Street	15/16
I-280	R0.1 / R1.5	SF-280 Concrete Barrier	Construct concrete barrier and retaining wall and widen shoulder and sidewalk in San Francisco at I-280 southbound off-ramp to John Daly Boulevard and San Jose Avenue Overcrossing	15/16
US 101	5 / 6	SF-101 Van Ness Pedestrian Tunnel Project	Construct pedestrian tunnel under Van Ness Avenue on US 101 in San Francisco between PM and 6.0	15/16
US 101	4.9 / 6.7	SF-101 Van Ness Bus Rapid Transit	Construct rapid transit bus lanes on Van Ness Avenue in San Francisco on US 101 from 16th Street to Lombard Street on Van Ness Avenue.	15/16
I-280	R4.2 / R6.6	SF-280 Deck/Drainage Repair	Bridge rehabilitation repair for drainage and ponding in San Francisco on I-280, bridge #34-46	16/17
I-80	5.8 / 7.8	SF-80-SFOBB West Span Seismic Damper Retrofit	Replace seismic dampers on west span in San Francisco on I-80 at the San Francisco-Oakland Bay Bridge	16/17

Route	Post Mile	Project Name	Description	Fiscal Year
I-80	R5.9 / R7.7	Replace Travelers and Rails on SFOBB	Replace travelers and Rails on San Francisco-Oakland Bay Bridge	16/17
I-80	4.9 / 5.9	TJPA Bus Storage Facility Project	New bus storage facility under I-80 in San Francisco on I-80 from 3rd Street to 2nd Street	16/17
I-80	R0.7 / 4.1	SF-001-19th Avenue Bulb-outs	Construct bus and pedestrian bulb-out improvements in San Francisco in various locations from Junipero Serra Boulevard to Lincoln Way	16/17
US 101	2.03 / 2.03	SF 101- Alemany Circle UC	Bridge rehabilitation on US 101 at the Alemany Circle undercrossing in San Francisco	17/18
I-80	5.3 / 8.8	SFOBB Steel Painting	Structural steel painting in San Francisco on the west span of the San Francisco-Oakland Bay Bridge	17/18
US 1	R0 / R6.9	SF-001 Highway Rehab from 280 to Ruckman Avenue	Rehabilitate roadway in San Francisco from I-280 to Ruckman Avenue undercrossing	17/18
I-80	4.9 / 5.9	TJPA Downtown Extension of Caltrain Project	Phase 2 of Transbay Center Program, extending Caltrain line to new terminal crossing under I-80 at I-80 on 2nd Street in the city and county of San Francisco	19/20

Source: Caltrans, San Francisco List of Upcoming Projects for Construction, February 26, 2016.

San Francisco County Transportation Authority

Freeway Corridor Management Study — Phase 2

Appendix C:

Traffic Analysis Methodology and Results

In support of the

SM/SF-101 and SF-280 Managed Lanes Feasibility Study

FEHR PEERS

Executive Summary

This technical memorandum presents the traffic analysis for providing (a high-occupancy vehicle (HOV) lane or high-occupancy toll (HOT) lane (also known as an express lane), by either converting an existing general-purpose (GP) lane or adding a new lane along US-101 and I-280. HOV and HOT lanes are also identified as managed lanes in this memorandum. Along US-101, a lane conversion would occur in the northbound direction between the I-380 interchange and the Harney Way interchange, and in the southbound direction between the I-280 and I-380 interchanges. South of the I-380 interchange, the San Mateo 101 Managed Lanes Project[1] would add an additional lane to the corridor to support an HOV lane or HOT lane. Along I-280, a lane addition would occur in the northbound direction between the 18th Street interchange and I-280 terminus at 5th and King Street in Downtown San Francisco, and a lane conversion would occur in the southbound direction between the start of I-280 and the US-101 interchange.

In this memorandum, "project limits" refer to the extents of the freeway where managed lane implementation is proposed. The geographic area considered in this analysis extends beyond the exact project limits to capture the effects of the proposed HOV or Express Lanes on the surrounding areas and is referred to as "study corridor". The study corridor is located within San Francisco County and San Mateo County, and traverses the City of San Francisco, Brisbane, and South San Francisco.

The study corridor for this analysis is illustrated in **Figure 1** and is summarized below:

- US-101 Northbound: South of Airport Boulevard off-ramp to Vermont Street off-ramp
- US-101 Southbound: Cesar Chavez Street on-ramp to I-380 off-ramp
- I-280 Northbound: Ocean Avenue on-ramp to King Street off-ramp
- I-280 Southbound: 6th Street on-ramp to the Ocean Avenue on-ramp

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[1] San Mateo County Transportation Authority, in coordination with Caltrans and City/County Association of Governments of San Mateo proposes to build continuous managed lanes on US-101 in San Mateo extending from I-380 in San Bruno to San Antonio Road in Mountain View.

The analysis scenarios presented in this technical memorandum include:

- Year 2020 No Build
- Year 2020 HOV2+ Convert
- Year 2020 HOV3+ Convert
- Year 2020 Express Lanes Convert

Year 2020 represents the near-term horizon year, the earliest that the proposed Project would open. The analysis time periods presented in this memorandum are the AM and PM peak one-hour of vehicular traffic demand. Using a deterministic model, the project team identified two key Measures of Effectiveness (MOEs) to assess how traffic operations would change with the HOV lane or HOT lane conversion:

- Travel-time estimates: for GP, HOV, and HOT lanes for vehicles traveling between the I-380/US-101 interchange and the northern terminus of I-280 at King Street in San Francisco.
- Person throughput: The total number of people passing a selected screen-line location in the corridor, across both transit and driving modes.

Findings and Recommendations

Person throughput results are summarized in **Figure 2** and **Figure 3**. Travel time results from this analysis are summarized in **Figure 4.** Key conclusions from this analysis include:

- The travel time results indicate that under all three Build scenarios, the managed lane travel times would be substantially better than the GP lane travel times.
- Compared to the No-Build conditions, the GP lane travel times would generally worsen under Build conditions. The HOT lane scenario would have the best GP lane travel times out of the three Build scenarios, and shows an improvement over the No-Build conditions in northbound AM travel times and southbound PM travel times.
- All Build scenarios show an improvement in the total person throughput, with the exception of HOV3+ scenario where the person throughput would decrease on both directions of US-101. The HOV2+ and HOT lane scenarios show similar levels of improvement in person throughput, with the HOV2+ performing slightly better.
- Transit ridership, travel times and reliability will substantially increase in all the managed lane scenarios.
- On US-101 northbound, the Project does not propose a managed lane between the county line and the I-280 interchange. During the AM peak hour, congestion from the downstream

bottleneck at the Hospital Curve, which is outside the project limits, will extend to SF/SM county limits near the terminus of the proposed managed lane. This could potentially cause delays for drivers in the managed lane needing to access I-280 and Downtown SF, as they would need to weave across several lanes within the congested section.

- Based on MOEs evaluated in this analysis, both HOV2+ and HOT lane options would be conceptually feasible for the managed lane project and serve to further the goals of the Project.
- Suggested next steps are as follows:
  - *A more comprehensive analysis of traffic impacts, using advanced methods such as microsimulation, and the effect of different operational parameters (such as hours of operation, pricing formulas etc.) will be needed in subsequent project development phases.*
  - *Comprehensive traffic forecasts will be needed for both project opening year and design year for the entire study corridor.*
  - *The project team should consider evaluating an option to extend the managed lanes on US-101 northbound from the SF/SM county limits into the I-280 northbound merge. This would improve the efficiency of the managed lanes by allowing I-280 bound users to bypass the congestion originating at the Hospital Curve outside of the project limits.*

Analysis Methodology and Assumptions

This section describes the methodology and assumptions for the traffic analysis. The analysis, prepared by the ETC and Fehr & Peers team in coordination with SFCTA, is a high-level assessment of the future traffic operational performance on the study corridors. It involves establishing existing traffic conditions, refining travel model outputs to forecast future demand, followed by applying deterministic methods to assess the sufficiency of the study roadways to accommodate the vehicular demand, and finally quantifying the performance of the study roadways through selected measures of effectiveness.

The purpose of the study was to assess the overall performance of the proposed Managed Lane alternatives to determine whether any of the options should move forward in the planning and project development process. The analysis was a high-level assessment of future peak hour conditions to provide insight on the expected operation to establish overall feasibility of the alternatives. The level of detail and accuracy was commensurate with the data and forecasts available, and should be considered a precursor to more detailed studies (involving refined forecast and microsimulation traffic analysis) to be conducted during subsequent project development phases.

Analysis Study Corridors

As described above, the study corridor is located within San Francisco County and San Mateo County, and traverses the Cities of San Francisco, Brisbane, and South San Francisco. **Figure 1**, illustrates the study corridors for this analysis and is summarized below and extends beyond the exact project limits to capture the effects of the proposed HOV or HOT lane on the surrounding areas:

- US-101 Northbound: South of Airport Boulevard off-ramp to Vermont Street off-ramp
- US-101 Southbound: Cesar Chavez Street on-ramp to I-380 off-ramp
- I-280 Northbound: Ocean Avenue on-ramp to King Street off-ramp
- I-280 Southbound: 6th Street on-ramp to the Ocean Avenue on-ramp

Study Scenarios and Time Periods

The analysis scenarios presented in this technical memorandum are:

- Year 2020 No Build
- Year 2020 HOV2+ Convert
- Year 2020 HOV3+ Convert
- Year 2020 Express Lanes Convert

Year 2020 represents the near-term horizon year the earliest that the proposed Project would open. The analysis time periods presented in this memorandum are the AM and PM peak one-hour of congestion.

Existing and Future Traffic Volume Development

This section describes the methodology used to develop existing demand and Year 2020 forecasts.

Existing Conditions Demand Development

Existing conditions demand refers to the hourly “unconstrained” freeway demand, i.e., the number of vehicles that would appear at each freeway section, if not constrained by bottlenecks. Evaluating the unconstrained demand allows for the identification of bottlenecks that may be "hidden" by queuing from a downstream bottleneck, or new downstream bottlenecks that may appear if the controlling bottlenecks are relieved. The existing conditions demand used in this analysis was obtained from the FCMS Existing Conditions Report.[2]

Year 2020 No-Build Demand Development

Year 2020 forecasts were based on recent SF-CHAMP model outputs for freeway segments within San Francisco County and the C/CAG model for freeway segments within San Mateo County. Year 2020 No Build demand volumes were derived for each freeway mainline based on the net increase between the baseline (or existing) year and future year travel demand models.

Year 2020 Build Demand Development

With the 2020 No-Build demand established, the 2020 Build (or Managed Lanes) scenario demands were developed based on the net increase between the 2020 No-Build and 2020 Build travel models. 2020 Build C/CAG model runs were unavailable; therefore, the SF-CHAMP model runs,

[2] SFCTA FCMS – Phase 2 Existing Conditions Report, AECOM, October 13, 2016.

which include study corridor segments south of the San Francisco County line, were used in the development of 2020 Build demand volumes.

Year 2020 Vehicle Occupancy and Managed Lane Demand Forecasts

Another key step in the traffic volume development process is estimating the distribution of vehicle occupancies, i.e. the share of users driving alone and those eligible for carpooling (HOV2+ and HOV3+). The method for estimating vehicle occupancies was developed in close coordination with the Project team (including SFCTA staff) and is described below:

1. Existing vehicle occupancy data is consistent with those summarized in the FCMS Existing Conditions report (Tables 5 and 6).
2. Average vehicle occupancy rates were derived from the existing occupancy data based on: peak hour (AM or PM), direction (NB or SB), freeway (101 or 280) and county (SF or SM).
3. These average vehicle occupancy rates for the 2020 No-Build scenario were developed based on the net increment in the HOV2+ and HOV3+ percentages between the existing and 2020 No-Build travel demand models (C/CAG for San Mateo freeway segments and SF-CHAMP for San Francisco freeway segments).
4. The average occupancy rates for the 2020 Build scenarios were developed based on the net change in the HOV2+ and HOV3+ percentages between the 2020 No-Build and 2020 Build SF-CHAMP travel demand models.

The portion of "eligible" managed lane users that would be occupying the managed lane was estimated based on the travel model outputs for each of the scenarios evaluated.

Traffic Analysis Assumptions

This section details the assumptions used in the analysis.

Capacity and Delay Calculation Assumptions

The analysis included per lane capacity assumptions to estimate the resulting delay in the general purpose lanes. **Table 1** illustrates the capacity assumptions used in the traffic analysis.

Table 1: Capacity Assumptions for Traffic Analysis

Segment Type	Available Capacity in Vehicles Per Hour Per Lane	
	I-280	US-101
General Purpose Lane	2,000	1,900
Auxiliary Lane	1,000	1,000
Managed Lane (HOV2+, HOV3+ or HOT)	1,650	1,650

Developed by ETC and Fehr & Peers in coordination with SFCTA.

Capacity assumptions were supplemented by identifying existing bottlenecks and adjusting the available capacity based on the number of vehicles served at that location. Bottleneck delays were estimated based on the amount of "unserved" demand. Delays associated with locations outside the study corridor, such as the I-280 northbound terminus at 5th and King Street, were accounted for based on existing available data. The Project adds a managed lane on I-280 northbound from the 18th Street on-ramp to the freeway terminus at 5th and King Street. The additional capacity provided by the managed lane was accounted for in estimating delays for both GP lane users and managed lane users.

Travel Time Assumptions

Travel times between the I-380/US-101 interchange and the northern terminus of I-280 at King Street in San Francisco, were calculated for the GP, HOV, and HOT lanes, across all scenarios. Additionally, travel time savings for HOV and HOT lane users were estimated. Travel time calculations were estimated assuming an uncongested travel speed of 55 miles per hour along the GP, HOV, and HOT lanes, and assuming a congested travel speed of 15 miles per hour for vehicles in queue approaching bottlenecks.

Person Throughput

This analysis evaluated the change in person throughput in each of the Build scenarios compared to the No-Build scenario using an average occupancy of 2 persons in HOV2 vehicles and 3.5 persons in HOV3 vehicles. Transit and shuttle bus passenger ridership was included in the person throughput estimates and were taken directly from the SF-CHAMP travel demand model.

Measures of Effectiveness

The Measures of Effectiveness (MOEs) provided in this analysis illustrate how traffic operations would change with the HOV lane or HOT lane conversion. The following MOEs are described below.

- General-purpose lane delay: delays experienced by drivers in the GP lanes within the study corridors.
- Managed lane travel-time savings: travel-time savings provided by the proposed HOV and HOT lanes within the study corridors.
- Travel-time estimates: travel time for GP, HOV, and HOT lanes for vehicles traveling between the I-380/US-101 interchange and the northern terminus of I-280 at King Street in San Francisco.
- Person throughput: The total number of people passing a selected screen-line location in the corridor, across both transit and driving modes.

In addition to the MOEs listed above, managed lanes usage was also observed for each scenario.

Analysis Findings

The forecasted traffic growth during the peak hours between the base year (2015) and the analysis horizon year (2020) is relatively low (approximately two to four percent); therefore, traffic conditions in the No-Build scenario will mostly be similar to existing conditions, with the exception of a few locations where the growth in traffic would result in new bottleneck locations under the No-Build conditions.

Figure 2 and **Figure 3** illustrate the US-101 and I-280 person throughput at the screen line locations for each study scenario, respectively. **Figure 4** illustrates the travel time summaries for each study scenario. Supporting information is provided in the **Appendix** at the end of this document.

Summary of Findings

Table 2 and **Table 3** summarize the two key MOEs identified by the project team, the total person throughput at selected screen line locations and travel time for users traveling along the HOV and HOT lanes (between I-380 to Downtown SF), respectively.

As listed, all Build scenarios show an improvement in the total person throughput, with the exception of US-101 northbound and southbound, HOV3+ scenario, where the person throughput would decrease due to the underutilization of the HOV3+ lane and the severity of the bottlenecks on the GP lanes. Under the remaining scenarios, the person throughput is expected to increase between approximately 5-percent and 45-percent, depending on the study corridor, peak hour, and Build scenario. Across the three Build scenarios evaluated, the HOV2+ typically performs best.

The travel time results indicate that under all three Build scenarios, the managed lane travel times would be substantially better than the GP lane travel times; however, the GP travel times would degrade compared to No Build conditions under most of the scenarios evaluated. Of the Build scenarios, the GP lanes would have the worst travel times under the HOV3+ scenario and would perform best under the HOT lane scenario.

Table 2: Change in Person Throughput from No-Build Scenario

Freeway	Screen-line Location	Scenario	AM	PM
US-101 (Northbound)	Between Harney Way off-ramp and Harney Way on-ramp (SF County Line)	2020 HOV2+	+14%	+13%
		2020 HOV3+	**-12%**	**-9%**
		2020 HOT	+7%	+14%
US-101 (Southbound)	Between Bayshore Blvd on-ramp and Alana Way off-ramp (SF County Line)	2020 HOV2+	+17%	+19%
		2020 HOV3+	**-5%**	**-8%**
		2020 HOT	+11%	+26%
US-280 (Northbound)	Between 18th Street on-ramp and 6th Street off-ramp	2020 HOV2+	+40%	+18%
		2020 HOV3+	+33%	+10%
		2020 HOT	+24%	+8%
US-280 (Southbound)	Between 18th Street off-ramp and 18th Street on-ramp	2020 HOV2+	+16%	+43%
		2020 HOV3+	+7%	+19%
		2020 HOT	+2%	+43%

Bold indicates a negative change in person throughput.

Table 3: Travel Times Summary (minutes)

Direction	Scenario	AM Peak Hour		PM Peak Hour	
		GP Lane	Managed Lane	GP Lane	Managed Lane
Northbound I-380 to Downtown SF	2020 No Build	24	-	20	-
	2020 HOV2+	22	17	**23**	12
	2020 HOV3+	22	17	**26**	11
	2020 HOT	21	17	**22**	12
Southbound Downtown SF to I-380	2020 No Build	17	-	15	-
	2020 HOV2+	**19**	11	**17**	11
	2020 HOV3+	**27**	11	**28**	11
	2020 HOT	**21**	11	12	11

Bold indicates worsening of travel from the No-Build scenario.

Northbound AM Peak Hour Conditions

US-101 Northbound

Under the 2020 No-Build and Build scenarios evaluated, the primary bottlenecks will occur on the section of the freeway just north of the 380/101 interchange. between the Grand Avenue off-ramp and the Airport Boulevard on-ramp. (Note: This analysis assumes that the demand approaching this location is not constrained by any upstream bottlenecks and that the managed lane project south of I-380 will be under operation).

- GP lane delay: In all scenarios evaluated, the congestion in the GP lanes from the bottlenecks upstream of the Grand Avenue off-ramp would extend south of I-380, outside of the project limits. The No-Build scenario would experience the least amount of delay (6 minutes) in the GP lanes, followed by the HOV2+ and HOT lane scenarios (9-10 minutes, followed by the HOV3+ scenario (19 minutes). The GP lanes perform worse in the Build scenarios due to the heavy demand and reduced overall capacity at the bottleneck compared to the No-Build scenario.
- Managed lane travel time savings: Within the study corridor limits, the managed lanes would provide a travel time savings of approximately 2 minutes over the GP lanes in all three Build scenarios. The managed lane travel time savings within the study corridor are diminished relative to the GP lane delays since the congestion in the GP lanes extends well beyond the project limits.
- Person throughput: The person throughput at the screen line location would show an increase in the HOV2+ and HOT lane scenarios (by 14% and 7%) compared to the No-Build scenario, while the HOV3+ scenario would show a decrease (of 12%). Transit service will substantially increase in the three Build scenarios.
- Managed lane use: In the HOV2+ and HOT lane scenarios, the managed lane usage would be consistently high between 1500 and 1700 vph, while in the HOV3+ scenario, the managed lane use would be around 300 to 400 vph due to the low overall HOV3 percentage in the traffic stream.

North of the Airport Boulevard bottleneck, conditions will be generally free of congestion up to the SF/SM county line across all scenarios. Under existing conditions, the Hospital Curve bottleneck almost extends back to the SF/SM county limits. The bottleneck and corresponding queue is expected to continue through 2020 No Build and Build scenarios. Since the managed lanes end at the Harney Way interchange, the managed lane vehicles will not experience any additional benefit through this bottleneck. Furthermore, managed lanes vehicles accessing the I-280 corridor will weave across several GP lanes within this congested section. Downstream of the Hospital Curve bottleneck, conditions will be generally free of congestion except at the approach to the lower deck of the Bay Bridge in all scenarios.

I-280 Northbound

The primary bottlenecks in No-Build and all Build scenarios evaluated would occur at the following locations – in the three-lane section between US-101 northbound on-ramp and the Cesar Chavez Street off-ramp, and on the sections of the freeway approaching 5th and King Street, and 6th and Brannan Street in Downtown San Francisco. GP lane delay: All three build scenarios would have reduced GP lane delay compared to the No-Build scenario, primarily due to the managed lane add between the 18th Street interchange and the freeway terminus at 5th and King Street. This analysis does not assess the delays approaching the freeway terminus at 6th and Brannan Street.

- Managed lane travel time savings: Within the study corridor limits, the manage lanes would provide a travel time savings of approximately 3 minutes over the GP lanes in the HOV2+ and HOV3+ scenarios and approximately 2 minutes in the HOT lane scenario.
- Person throughput: The person throughput at the screen line location would show a 25-percent to 40-percent increase in all three Build scenarios due to the managed lane add. Transit service is also assumed to substantially increase in all three Build scenarios.
- Managed lane use: Managed lane use will be highest in the HOV2+ scenario followed by the HOT lane scenario followed by the HOV3+ scenario.

Travel Time Estimates – I-380 to Downtown San Francisco (5th and King)

As shown in **Figure 4**, under the managed lanes scenarios, travel times for users traveling northbound in the AM peak hour would improve by 2-3 minutes (from 24 minutes to 21-22 minutes) in the GP lanes and by 7 minutes (from 24 minutes to 17 minutes) in the managed lanes.

Northbound PM Peak Hour Conditions

US-101 Northbound

In the 2020 No-Build and all three Build scenarios evaluated, a series of bottlenecks will occur between Harney Way and Grand Avenue. (Note: This analysis assumes that the demand approaching this location is not constrained by any upstream bottlenecks and that the managed lanes project south of I-380 will be under operation).

- GP lane delay: The No-Build scenario would experience the least amount of delay in the GP lanes, followed by the HOT and HOV2+ lane scenarios, followed by the HOV3+ scenario.

The GP lanes worsens in the Build scenarios due to the heavy demand and reduced overall capacity at the bottleneck compared to the No-Build scenario.

- Managed lane travel time savings: Within the study corridor limits, the managed lanes would provide a travel time savings of approximately 13 minutes over the GP lanes in the HOV3+ lane scenario, 11 minutes in the HOV2+ scenario and 9 minutes in the HOT lane scenario.
- Person throughput: The person throughput at the screen line location would show an increase in the HOV2+ and HOT lane scenarios (by 13% and 14%) compared to the No-Build scenario, while the HOV3+ scenario would show a decrease (of 9%). Transit service is assumed to substantially increase in the three Build scenarios.
- Managed lane use: Managed lane use would be highest in the HOT lane scenario at 1700 vph throughout the managed lane section. In the HOV2+ scenario, the managed lane usage would also be high, between 1400 and 1650 vph, while in the HOV3+ scenario, the managed lane use would be around 200 to 300 vph due to the low overall HOV3 percentage in the traffic stream.

North of the SF/SM county line, a bottleneck is present at the entrance to the lower deck of the Bay Bridge. This bottleneck will create queues just north of the 280/101 interchange in all scenarios. This analysis does not evaluate delays due to this bottleneck.

I-280 Northbound

The primary bottlenecks in all three scenarios evaluated would occur on the sections of the freeway approaching 5th and King Street, and 6th and Brannan Street in Downtown San Francisco.GP lane delay: All three build scenarios would have reduced GP lane delay compared to the No-Build scenario, primarily due to the addition of a managed lane between the 18th Street interchange and the freeway terminus.

- Managed lane travel time savings: Within the study corridor limits, the managed lanes would provide a travel time savings of approximately 1 minute over the GP lanes in all three Build scenarios.
- Person throughput: The person throughput at the screen line location would show an increase of 10-percent to 20-percent in all three Build scenarios.
- Managed lane use: Managed lane use will be highest in the HOV2+ scenario followed by the HOT lane scenario followed by the HOV3+ scenario.

Travel Time Estimates – I-380 to Downtown San Francisco (5th and King)

As shown in **Figure 2**, under the managed lanes scenarios, GP lane users traveling northbound in the PM peak hour would experience an increase in travel time by 3-6 minutes (from 20 minutes to 22-26 minutes). However, travel times for HOV and HOT lane users would decrease by 8-9 minutes (from 20 minutes to 11-12 minutes).

Southbound AM Peak Hour Conditions

US-101 Southbound

In 2020 No-Build and all three Build scenarios evaluated, the primary bottlenecks will occur on the four-lane sections of the freeway between Alana Way on-ramp and Sierra Point Parkway off-ramp, and between Bayshore Boulevard on-ramp and Alana Way off-ramp. GP lane delay: The No-Build scenario would experience the least amount of delay in the GP lanes, followed by the HOV2+ and HOT lane scenarios, followed by the HOV3+ scenario. The GP lanes perform worse in the Build scenarios due to the heavy demand and reduced overall capacity at the bottleneck compared to the No-Build scenario.

- Managed lane travel time savings: Within the study corridor limits, users traveling southbound on US-101 would experience a travel time savings in the managed lane of approximately 7 minutes over the GP lanes in all three Build scenarios. Users traveling southbound on I-280 then merging on to US-101 would experience additional travel time savings due to the continuous managed lane from I-280 southbound to US-101 southbound. HOV and HOT users would save 16 minutes in the HOV3+ scenario, 10 minutes in the HOT lane scenario and 8 minutes in the HOV2+ scenario.
- Person throughput: The person throughput at the screen line location (SF/SM county line) would show an increase in the HOV2+ and HOT lane scenarios (by 17% and 11%) compared to the No-Build scenario, while the HOV3+ scenario would show a decrease (of 5%). Transit service is assumed to substantially increase in the three Build scenarios.
- Managed lane use: Managed lane use would be highest in the HOT lane scenario at 1500 -1700 vph. In the HOV2+ scenario, the managed lane usage would be 1300 vph. While in the HOV3+ scenario, the managed lane use would be around 200 to 300 vph due to the low overall HOV3 percentage in the traffic stream.

I-280 Southbound

Traffic volumes entering the freeway are constrained by the capacity of the intersections at 6th and Brannan and at 5th and King Street. The No-Build and Build scenarios would be able to accommodate the constrained demand with no congestion on the freeway. The Project proposes striping improvements at the 280/101 interchange to provide an additional GP lane on the I-280 to US-101 southbound connector, which would increase throughput and the available capacity.

- GP lane delay: No GP lane delay is estimated in the 2020 No Build or 2020 Build scenarios.
- Managed lane travel time savings: No managed lane travel time savings are estimated since there are no GP lane delays estimated.
- Person throughput: The person throughput at the screen line location would show an increase compared to the No-Build scenario of 16% in the HOV2+ scenario, 7% in the HOV3+ scenario and 2% in the HOT lane scenario.
- Managed lane use: Managed lane use will be generally low in all three build scenarios due to relatively low levels of congestion.

Travel Time Estimates – Downtown San Francisco (5th and King) to I-380

As shown in **Figure 2**, under the managed lanes scenarios, southbound GP travel times would worsen by 2-10 minutes (from 17 minutes to 19-27 minutes) due to the reduced GP lane capacity along US-101. Users in the managed lane would experience a decrease in travel time by 6 minutes (from 17 minutes to 11 minutes).

Southbound PM Peak Hour Conditions

US-101 Southbound

In 2020 No-Build and all three Build scenarios evaluated, traffic volumes entering southbound 101 will be constrained at the Hospital Curve bottleneck. In the 2020 No-Build, HOV2+ and HOT lane scenarios, conditions will generally be free of congestion from Hospital Curve to the 380/101 interchange in all scenarios. In the HOV3+ scenario however, a series of new bottlenecks would occur near the interchanges of Produce Avenue, Airport Boulevard, Sierra Point Parkway and Alana Way. These bottlenecks would occur due to reduced GP lane capacity due to the lane conversion and relatively low managed lane usage under the HOV3+ scenario.

- GP lane delay: All scenarios would experience little to no delay on the GP lanes with the exception of the HOV3+ scenario.
- Managed lane travel time savings: In the HOV2+ and HOT lane scenarios, given there are no GP lane delays, there would not be any managed lane travel time savings within the study corridor limits. In the HOV3+ scenario, users traveling southbound on US-101 would experience a travel time savings in the managed lane of approximately 10 minutes over the

GP lanes. Users traveling southbound on I-280 and then merging on to US-101 would experience additional travel time savings due to the continuous managed lane from I-280 southbound to US-101 southbound. These users would save 11 minutes in the HOV3+ scenario.

- Person throughput: The person throughput at the screen line location would show a substantial increase in the HOV2+ and HOT lane scenarios (by 19% and 26%) compared to the No-Build scenario, while the HOV3+ scenario would show a decrease (of 8%). Transit service is assumed to substantially increase in the three Build scenarios.
- Managed lane use: Managed lane use would be highest in the HOT lane scenario at 1700 vph throughout the managed lanes section. In the HOV2+ scenario, the managed lane usage would be 1300 vph, while in the HOV3+ scenario, the managed lane use would be around 200 to 300 vph due to the low overall HOV3 percentage in the traffic stream.

I-280 Southbound

In all scenarios evaluated, a bottleneck would occur at the Monterey Boulevard off-ramp. Under the No Build scenario, the queue from the bottleneck is expected to extend beyond the US-101 interchange; however, under the Build scenarios, the queues from this bottleneck would reduce to US-101 southbound on-ramp or better. Additionally, under Build conditions, a new bottleneck is expected to occur in the three-lane section of the freeway between Pennsylvania Avenue on-ramp and the US-101 off-ramp.

- GP lane delay: The GP lanes would experience the least amount of delay in the HOT lane scenario, followed by the No-Build scenario, and the two HOV scenarios.
- Managed lane travel time savings: Within the study corridor limits, the HOV3+ scenario would provide a travel time savings of approximately 6 minutes compared to the GP lanes, while the HOV2+ scenario would provide a travel time savings of 4 minutes and the HOT lane scenario would provide a travel time savings of 1 minute.
- Person throughput: The person throughput at the screen line location would show a substantial increase compared to the No-Build scenario of 43% in the HOV2+ and HOT lane scenarios, and 19% in the HOV3+ scenario.
- Managed lane use: Managed lane use would be highest in the HOT lane scenario between 800 vph to 1500 vph. In the HOV2+ scenario, the managed lane usage would be 500 to 800 vph, while in the HOV3+ scenario, the managed lane use would be around 200 vph due to the low overall HOV3 percentage in the traffic stream.

Travel Time Estimates – Downtown San Francisco (5th and King) to I-380

As shown in **Figure 4**, under the managed lanes scenarios, travel times for users traveling southbound in the PM peak hour in the GP lanes would worsen compared to the No-Build scenario by 13 minutes in the HOV3+ scenario, and 2 minutes in the HOV2+ scenario. Travel times in the GP lanes would improve by 3 minutes in the HOT lane scenario. Travel times would also improve in the managed lane by 4 minutes compared to the No-Build scenario (from 15 minutes to 11 minutes) in all three scenarios evaluated.

Conclusions and Recommendations

Conclusions from this analysis include:

- Traffic conditions in the No-Build scenario will operate similar to existing conditions, with the exception of a few locations where the growth in traffic would result in new bottleneck locations under the No-Build conditions.
- The bottleneck locations will largely remain the same in the Build scenarios compared to the No-Build scenarios. New bottlenecks would occur during the PM peak hour on US-101 southbound in the HOV3+ scenario, and on I-280 southbound in all three Build scenarios.
- On US-101 northbound, the Project does not propose a managed lane between the county line and the I-280 interchange. During the AM peak hour, congestion from the downstream bottleneck at the Hospital Curve will extend to the SF/SM county limits near the terminus of the proposed managed lane. Drivers maneuvering across the congested freeway, from the managed lane to the GP lanes to access the I-280 interchange, could result in additional delays in the managed lane and GP lanes.
- The peak managed lane usage would be the highest in the HOT lane scenario among the Build scenarios. In the HOV3+ scenario, the peak managed lane usage would be consistently low (not exceeding 400 vehicles per hour). The HOV2+ lanes would have a high peak usage on US-101, but would not exceed 800 vehicles per hour on I-280 in either of the peak hours evaluated.
- Transit ridership, travel times and reliability will substantially increase in all the managed lane scenarios.
- The travel time results indicate that under all three Build scenarios, the managed lane travel times would be substantially better than the GP lane travel times, however there are differences in how the GP lanes are affected in each scenario compared to the No-Build conditions. The GP lane travel times would increase the most under the HOV3+ scenario. Of the build scenarios, the GP lanes would perform the best under the HOT lane scenario.

- All Build scenarios show an improvement in the total person throughput, with the exception of HOV3+ scenario where the person throughput would decrease on US-101, primarily due to the underutilization of the HOV3+ lane and the severity of the bottlenecks created on the GP lanes. The HOV2+ and HOT lane scenarios show similar levels of improvement in person throughput, with the HOV2+ performing slightly better.
- Based on MOEs evaluated in this analysis, both HOV2+ and HOT lane options would be conceptually feasible for the managed lane project and serve to further the goals of the Project.

Suggested next steps are as follows:

- This study presents a preliminary traffic operation assessment of the proposed Managed Lane project. A full analysis of traffic impacts and the effect of different operational parameters will be needed in subsequent project development phases. Operational parameters may include hours of operation, pricing formulas for an Express/Toll lane operation, and the minimum occupancy requirements for HOVs. An analysis of the proposed Project's impact on travel time reliability, particularly for buses and shuttles, would be useful in weighing the relative tradeoffs for different types of freeway users. Comprehensive traffic forecasts will be needed for both project opening year and design year (20 years after opening), and differences between the SF CHAMP and C/CAG forecast models will need to be resolved. The additional traffic studies, and corresponding data collection, should be performed as part of the Project Initiation Document (PID) process, performed in parallel to the PID process (but technically outside of the document) or performed as part of the Project Approval and Environmental Document (PA/ED) process. Developing greater clarity during the PID process on the implications of the various options could significantly reduce the level of effort required in the PA/ED phase.
- The project team should consider evaluating an option to extend the managed lanes on US-101 northbound from the SF/SM county limits into the I-280 northbound merge. This would improve the efficiency of the managed lanes by allowing I-280 bound users to bypass the congestion originating at the Hospital Curve outside of the proposed project limits. As an alternative to more traditional expansion, other system management strategies to maintain free flow conditions within this freeway segment should be investigated.

LEGEND

Study Corridor

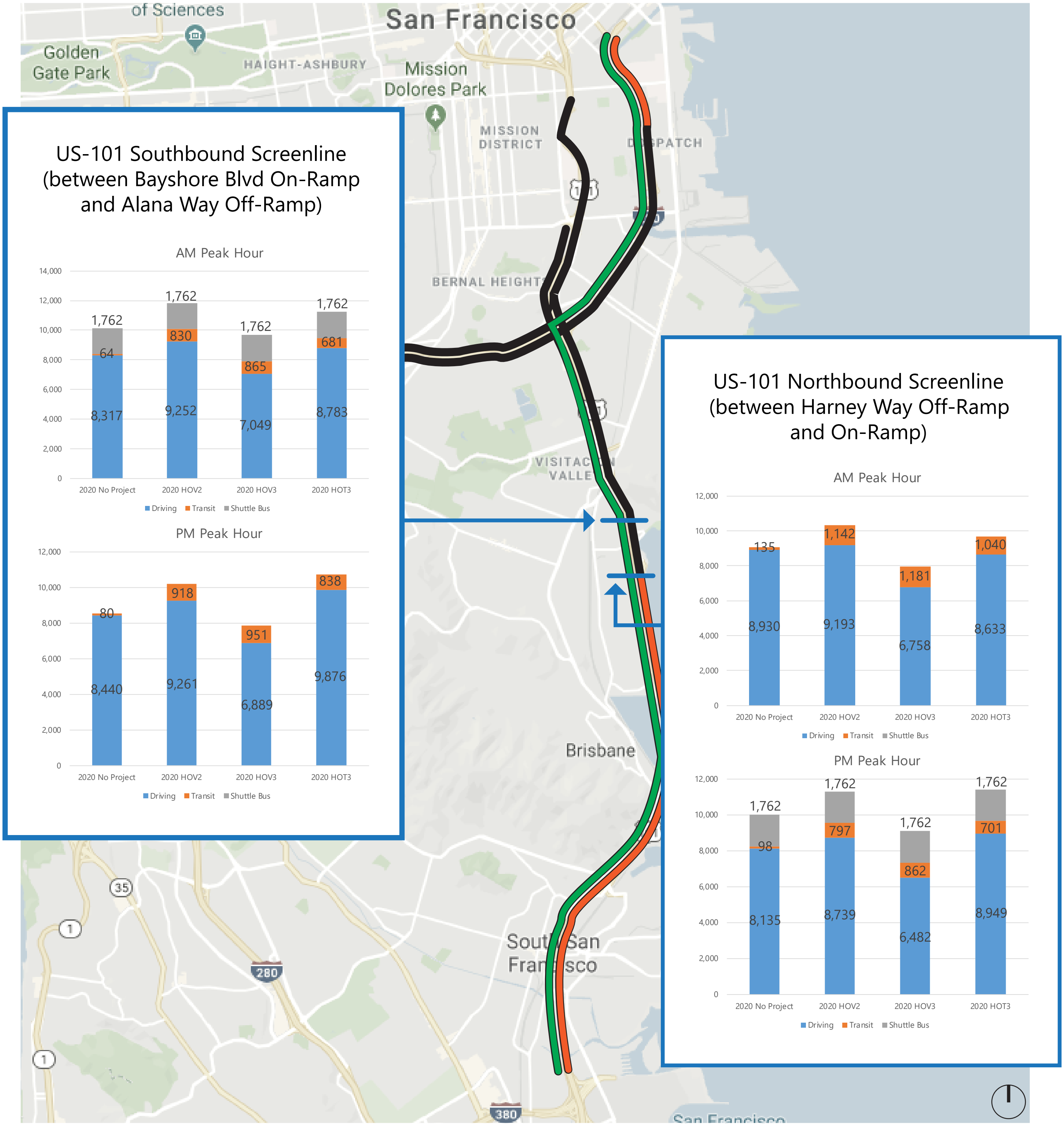
Northbound Manage Lane

Southbound Manage Lane

Figure 1

Study Area and Manage Lanes

\\Fpsf03.fpainc.local\data\Projects\2017_Projects\SF17-0945_SFCTA Managed Lanes Study\Graphics



LEGEND

Study Corridor

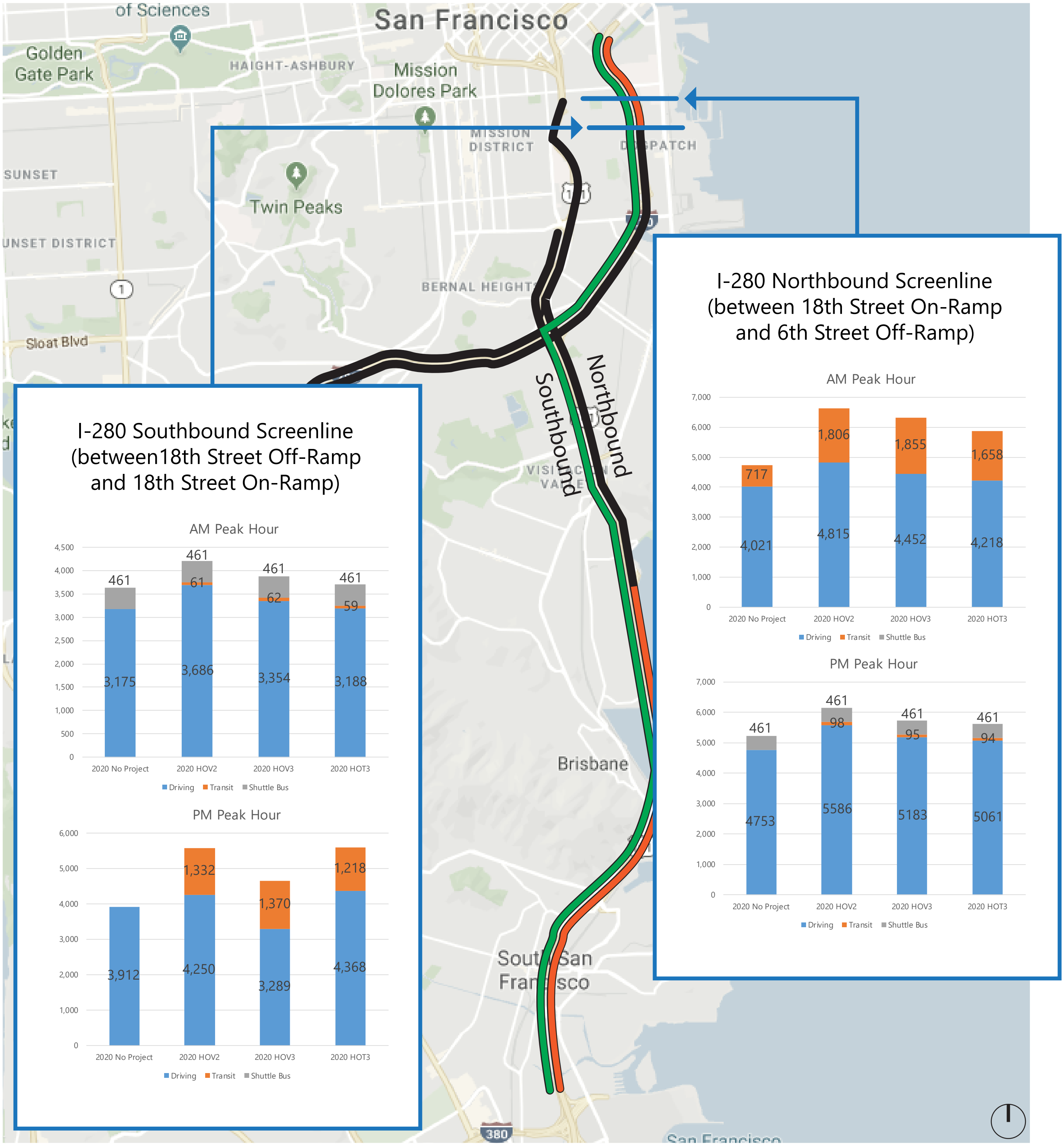
Northbound Manage Lane

Southbound Manage Lane

Figure 2

Year 2020 Results Summary
US-101 Person Throughput

\\Fpsf03.fpainc.local\data\Projects\2017_Projects\SF17-0945_SFCTA Managed Lanes Study\Graphics



LEGEND

Study Corridor

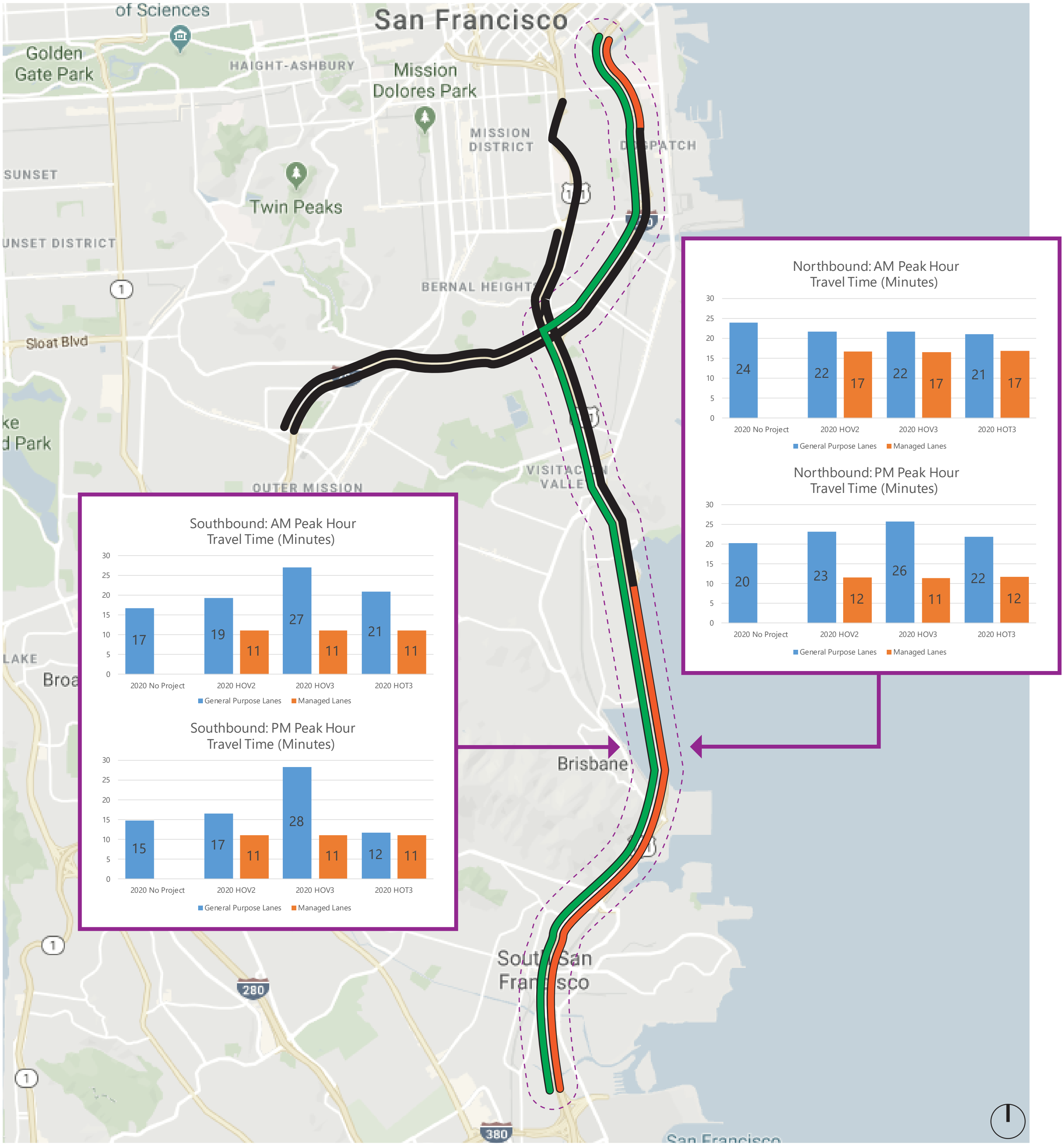
Northbound Manage Lane

Southbound Manage Lane

Figure 3

Year 2020 Results Summary
I-280 Person Throughput

\\Fpsf03.fpainc.local\data\Projects\2017_Projects\SF17-0945_SFCTA Managed Lanes Study\Graphics



LEGEND

- Study Corridor
- Northbound Manage Lane
- Southbound Manage Lane
- Travel Time Segment (between US-101, north of I-380 Ramps, and I-280 Ramp Terminus)

Figure 4

Year 2020 Results Summary Travel Time between US-101, North of I-380 Ramps, and I-280 Ramp Terminus

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Managed Lane Analysis: Methodology and Findings

Appendix

GP Lane Delay Estimates
Managed Lanes Travel Time Savings
Travel Time Estimates

GP Lane Delay Estimates

NORTHBOUND 101

Managed Lane limits: S/O Airport Bl Off to Harney Way Off to Harney Way On

AM Peak Hour

	2020 No-Build					2020 HOV2+ Convert					2020 HOV3+ Convert				2020 HOT Convert				
	Driving Person Throughput	Transit Person Throughput*	Shuttle Bus Person Throughput*	Total Person Throughput	Delay	Driving Person Throughput	Transit Person Throughput*	Shuttle Bus Person Throughput*	Total Person Throughput & % Change from NB	Delay	Driving Person Throughput	Transit Person Throughput*	Total Person Throughput & % Change from NB	Delay	Driving Person Throughput	Transit Person Throughput*	Shuttle Bus Person Throughput*	Total Person Throughput & % Change from NB	Delay
S/O Airport Bl Off														6.4					
Airport Bl Off																			
Airport Bl Off to Airport Bl On					2.3					4.5				7.6					5.5
Airport Bl On																			
Airport Bl On to Grand Av Off					3.5					4.5				4.5					4.5
Grand Av Off																			
Grand Av Off to Grand Av On																			
Grand Av On																			
Grand Av On to Oyster Point Bl Off																			
Oyster Point Bl Off																			
Oyster Point Bl Off to Oyster Point Bl On																			
Oyster Point Bl On																			
Oyster Point Bl On to Bayshore Bl Off																			
Bayshore Bl Off																			
Bayshore Bl Off to Sierra Point Pkwy Off																			
Sierra Point Pkwy Off																			
Sierra Point Pkwy Off to Sierra Point Pkwy On																			
Sierra Point Pkwy On																			
Sierra Point Pkwy On to Harney Way Off																			
Harney Way Off																			
Harney Way Off to Harney Way On	8930	135	0	9065		9193	1142	0	10335		6758	1181	7939		8633	1040	0	9673	
Harney Way On									+14%				-12%					+7%	
Harney Way On to 3rd St Off **COUNTY LINE**																			
3rd St Off																			
3rd St Off to Bayshore Bl/Paul Av Off																			
Bayshore Bl/Paul Av Off																			
Bayshore Bl/Paul Av Off to Bayshore Bl On																			
Bayshore Bl On																			
Bayshore Bl On to I-280 Off																			
I-280 Off																			
I-280 Off to Bayshore Bl/Silver Av Off																			
Bayshore Bl/Silver Av Off																			
Bayshore Bl/Silver Av Off to Bayshore Bl On																			
Alemany Bl Off																			
Alemany Bl Off to Alemany Bl On																			
Alemany Bl On																			
Alemany Bl On to I-280 N On																			
I-280 N On																			
I-280 N On to Cesar Chavez St Off																			
Cesar Chavez St Off																			
Cesar Chavez St Off to Cesar Chavez St On																			
Cesar Chavez St On																			
Cesar Chavez St On to Vermont St Off					1														
					6.8 minutes Total delay					9 minutes Total delay				18.5 minutes Total delay					10 minutes Total delay

PM peak hour

	2020 No-Build					2020 HOV2+ Convert					2020 HOV3+ Convert					2020 HOT Convert				
	Driving Person Throughput	Transit Ridership (Model)	Transit Ridership (Model)	Total Person Throughput	Delay	Driving Person Throughput	Transit Person Throughput*	Shuttle Bus Person Throughput*	Total Person Throughput & % Change from NB	Delay	Driving Person Throughput	Transit Person Throughput*	Shuttle Bus Person Throughput*	Total Person Throughput & % Change from NB	Delay	Driving Person Throughput	Transit Person Throughput*	Shuttle Bus Person Throughput*	Total Person Throughput & % Change from NB	Delay
S/O Airport Bl Off																				
Airport Bl Off																				
Airport Bl Off to Airport Bl On																				
Airport Bl On																				
Airport Bl On to Grand Av Off																				
Grand Av Off																				
Grand Av Off to Grand Av On										2.4					9.6					
Grand Av On																				
Grand Av On to Oyster Point Bl Off																				
Oyster Point Bl Off																				
Oyster Point Bl Off to Oyster Point Bl On					2.2					3.2					3.6					3.9
Oyster Point Bl On																				
Oyster Point Bl On to Bayshore Bl Off					1.7					1.7					1.7					1.6
Bayshore Bl Off																				
Bayshore Bl Off to Sierra Point Pkwy Off					1.6					1.8					2.7					2.1
Sierra Point Pkwy Off																				
Sierra Point Pkwy Off to Sierra Point Pkwy On																				
Sierra Point Pkwy On																				
Sierra Point Pkwy On to Harney Way Off					0.7					1.5					1.4					1.4
Harney Way Off																				
Harney Way Off to Harney Way On	8135	98	1762	9995		8739	797	1762	11298		6482	862	1762	9106		8949	701	1762	11412	
Harney Way On									+13%					-9%					+14%	
Harney Way On to 3rd St Off **COUNTY LINE**																				
3rd St Off																				
3rd St Off to Bayshore Bl/Paul Av Off																				
Bayshore Bl/Paul Av Off																				
Bayshore Bl/Paul Av Off to Bayshore Bl On																				
Bayshore Bl On																				
Bayshore Bl On to I-280 Off																				
I-280 Off																				
I-280 Off to Bayshore Bl/Silver Av Off																				
Bayshore Bl/Silver Av Off																				
Bayshore Bl/Silver Av Off to Bayshore Bl On																				
Alemany Bl Off																				
Alemany Bl Off to Alemany Bl On																				
Alemany Bl On																				
Alemany Bl On to I-280 N On																				
I-280 N On																				
I-280 N On to Cesar Chavez St Off																				
Cesar Chavez St Off																				
Cesar Chavez St Off to Cesar Chavez St On																				
Cesar Chavez St On																				
Cesar Chavez St On to Vermont St Off																				
					6.2 minutes Total delay					10.6 minutes Total delay					19.0 minutes Total delay					9.0 minutes Total delay

NOTES:

* Transit person throughput based on direct outputs from SF-CHAMP Model

* Does not include delays from hospital curve

Last updated: March 14, 2018

GP Lane Delay Estimates

SOUTHBOUND 101

Managed Lane limits: I-280 On to San Bruno Av/Paul Av Off through Produce Av On to I-380 Off

AM peak hour

Segment	2020 No-Build: Driving Person Throughput	2020 No-Build: Transit Person Throughput*	2020 No-Build: Shuttle Bus Person Throughput*	2020 No-Build: Total Person Throughput	2020 No-Build: Delay	2020 HOV2+ Convert Option 4: Driving Person Throughput	2020 HOV2+ Convert Option 4: Transit Person Throughput*	2020 HOV2+ Convert Option 4: Shuttle Bus Person Throughput*	2020 HOV2+ Convert Option 4: Total Person Throughput & % Change from NB	2020 HOV2+ Convert Option 4: Delay	2020 HOV3+ Convert: Driving Person Throughput	2020 HOV3+ Convert: Transit Person Throughput*	2020 HOV3+ Convert: Total Person Throughput & % Change from NB	2020 HOV3+ Convert: Delay	2020 HOT Convert: Driving Person Throughput	2020 HOT Convert: Transit Person Throughput*	2020 HOT Convert: Shuttle Bus Person Throughput*	2020 HOT Convert: Total Person Throughput & % Change from NB	2020 HOT Convert: Delay
Cesar Chavez St On to I-280 S Off																			
I-280 S Off																			
I-280 S Off to Alemany Bl On																			
Alemany Bl On																			
Alemany Bl On to San Bruno Av Off																			
San Bruno Av Off																			
San Bruno Av Off to San Bruno Av On																			
San Bruno Av On																			
San Bruno Av On to I-280 N On																			
I-280 On																			
I-280 On to San Bruno Av/Paul Av Off																			
San Bruno Av/Paul Av Off																			
San Bruno Av/Paul Av Off to Bayshore Bl Off																			
Bayshore Bl Off																			
Bayshore Bl Off to Bayshore Bl On (**LANE DROP**)														3.7					
Bayshore Bl/3rd St On																			
Bayshore Bl On to Alanna Wy/Beatty Av Off	8317	64	1762	10142	3.2	9252	830	1762	11844	5.0	7049	865	9676	8.9	8783	681	1762	11226	6.5
Alanna Wy/Beatty Av Off									+17%				-5%					+11%	
Alanna Wy/Beatty Av Off to Alanna Wy/Beatty Av On **COUNTY LINE**																			
Alanna Wy/Beatty Av On																			
Alanna Wy/Beatty Av On to Sierra Point Pkwy Off					2.5					3.3				3.4					3.3
Sierra Point Pkwy Off																			
Sierra Point Pkwy Off to Sierra Point Pkwy On																			
Sierra Point Pkwy On																			
Sierra Point Pkwy On to Airport Bl Off																			
Airport Bl Off																			
Airport Bl Off to Oyster Point Bl Off																			
Oyster Point Bl Off																			
Oyster Point Bl Off to Airport Bl On																			
Airport Bl On																			
Airport Bl On to Oyster Point Bl On																			
Oyster Point Bl On																			
Oyster Point Bl On to Grand Av Off																			
Grand Av Off																			
Grand Av Off to Produce Av Off																			
Produce Av Off																			
Produce Av Off to Produce Av On																			
Produce Av On																			
Produce Av On to I-380 Off																			
Total delay					5.7 minutes					8.3 minutes				16 minutes					9.8 minutes

PM peak hour

Segment	2020 No-Build: Driving Person Throughput	2020 No-Build: Transit Ridership (Model)	2020 No-Build: Transit Ridership (Model)	2020 No-Build: Total Person Throughput	2020 No-Build: Delay	2020 HOV2+ Convert Option 4: Driving Person Throughput	2020 HOV2+ Convert Option 4: Transit Person Throughput*	2020 HOV2+ Convert Option 4: Shuttle Bus Person Throughput*	2020 HOV2+ Convert Option 4: Total Person Throughput & % Change from NB	2020 HOV2+ Convert Option 4: Delay	2020 HOV3+ Convert: Driving Person Throughput	2020 HOV3+ Convert: Transit Person Throughput*	2020 HOV3+ Convert: Shuttle Bus Person Throughput*	2020 HOV3+ Convert: Total Person Throughput & % Change from NB	2020 HOV3+ Convert: Delay	2020 HOT Convert: Driving Person Throughput	2020 HOT Convert: Transit Person Throughput*	2020 HOT Convert: Shuttle Bus Person Throughput*	2020 HOT Convert: Total Person Throughput & % Change from NB	2020 HOT Convert: Delay
Cesar Chavez St On to I-280 S Off																				
I-280 S Off																				
I-280 S Off to Alemany Bl On																				
Alemany Bl On																				
Alemany Bl On to San Bruno Av Off																				
San Bruno Av Off																				
San Bruno Av Off to San Bruno Av On																				
San Bruno Av On																				
San Bruno Av On to I-280 N On																				
I-280 On																				
I-280 On to San Bruno Av/Paul Av Off																				
San Bruno Av/Paul Av Off																				
San Bruno Av/Paul Av Off to Bayshore Bl Off																				
Bayshore Bl Off																				
Bayshore Bl Off to Bayshore Bl On (**LANE DROP**)																				
Bayshore Bl/3rd St On																				
Bayshore Bl On to Alanna Wy/Beatty Av Off	8440	80	0	8520		9261	918	0	10179		6889	951	0	7840	3.4	9876	838	0	10714	
Alanna Wy/Beatty Av Off									+19%					-8%					+26%	
Alanna Wy/Beatty Av Off to Alanna Wy/Beatty Av On **COUNTY LINE**																				
Alanna Wy/Beatty Av On																				
Alanna Wy/Beatty Av On to Sierra Point Pkwy Off															1.9					
Sierra Point Pkwy Off																				
Sierra Point Pkwy Off to Sierra Point Pkwy On																				
Sierra Point Pkwy On																				
Sierra Point Pkwy On to Airport Bl Off										1.0					4.0					
Airport Bl Off																				
Airport Bl Off to Oyster Point Bl Off																				
Oyster Point Bl Off																				
Oyster Point Bl Off to Airport Bl On																				
Airport Bl On																				
Airport Bl On to Oyster Point Bl On																				
Oyster Point Bl On																				
Oyster Point Bl On to Grand Av Off																				
Grand Av Off																				
Grand Av Off to Produce Av Off										0.2					1.8					
Produce Av Off																				
Produce Av Off to Produce Av On																				
Produce Av On																				
Produce Av On to I-380 Off																				
Total delay					0.0 minutes					1.2 minutes					11.1 minutes					0.0 minutes

NOTES:

* Transit person throughput based on direct outputs from SF-CHAMP Model

Last updated: March 14, 2018

GP Lane Delay Estimates

NORTHBOUND 280

AM peak hour

	Driving Person Throughput	Transit Person Throughput*	Shuttle Bus Person Throughput*	Total Person Throughput	Delay	Driving Person Throughput	Transit Person Throughput*	Shuttle Bus Person Throughput*	Total Person Throughput & % Change from NB	Delay	Driving Person Throughput	Transit Person Throughput*	Total Person Throughput & % Change from NB	Delay	Driving Person Throughput	Transit Person Throughput*	Shuttle Bus Person Throughput*	Total Person Throughput & % Change from NB	Delay
	2020 No-Build					2020 HOV2+ Convert					2020 HOV3+ Convert				2020 HOT Convert				
Ocean Av On to San Jose Av Off																			
San Jose Av Off																			
San Jose Av Off to Monterey Bl On																			
Monterey Bl On																			
Monterey Bl On to Alemany Bl Off					0.9					0.7				0.5					2.0
Alemany Bl Off																			
Alemany Bl Off to Alemany Bl On																			
Alemany Bl On																			
Alemany Bl On to US-101 S Off																			
US-101 S Off																			
US-101 S Off to US-101 N Off																			
US-101 N Off																			
US-101 N Off to US-101 N On																			
US-101 N On																			
US-101 N On to Cesar Chavez St Off					6.3					6.2				5.4					7.1
Cesar Chavez St Off																			
Cesar Chavez St Off to 25th St On																			
25th St On																			
25th St On to Mariposa St Off																			
Mariposa St Off																			
Mariposa St Off to 18th St On																			
18th St On																			
18th St On to 6th St Off	4021	717	0	4738		4815	1806	0	6621		4452	1855	6307		4218	1658	0	5876	
6th St Off									+40%				+33%					+24%	
6th St Off to King St					5.9					3.7				3.6					3.0
					13.1 minutes Total delay					10.6 minutes Total delay				9.5 minutes Total delay					12.1 minutes Total delay

PM peak hour

	Driving Person Throughput	Transit Ridership (Model)	Transit Ridership (Model)	Total Person Throughput	Delay	Driving Person Throughput	Transit Person Throughput*	Shuttle Bus Person Throughput*	Total Person Throughput & % Change from NB	Delay	Driving Person Throughput	Transit Person Throughput*	Shuttle Bus Person Throughput*	Total Person Throughput & % Change from NB	Delay	Driving Person Throughput	Transit Person Throughput*	Shuttle Bus Person Throughput*	Total Person Throughput & % Change from NB	Delay
	2020 No-Build					2020 HOV2+ Convert					2020 HOV3+ Convert					2020 HOT Convert				
Ocean Av On to San Jose Av Off																				
San Jose Av Off																				
San Jose Av Off to Monterey Bl On																				
Monterey Bl On																				
Monterey Bl On to Alemany Bl Off																				
Alemany Bl Off																				
Alemany Bl Off to Alemany Bl On																				
Alemany Bl On																				
Alemany Bl On to US-101 S Off																				
US-101 S Off																				
US-101 S Off to US-101 N Off																				
US-101 N Off																				
US-101 N Off to US-101 N On																				
US-101 N On																				
US-101 N On to Cesar Chavez St Off					0.7					0.6										1.1
Cesar Chavez St Off																				
Cesar Chavez St Off to 25th St On																				
25th St On																				
25th St On to Mariposa St Off																				
Mariposa St Off																				
Mariposa St Off to 18th St On																				
18th St On																				
18th St On to 6th St Off	4753	0	461	5214		5586	98	461	6146		5183	95	461	5739		5061	94	461	5616	
6th St Off									+18%					+10%					+8%	
6th St Off to King St					3.0					1.5					1.7					1.8
					3.7 minutes Total delay					2.1 minutes Total delay					1.7 minutes Total delay					2.9 minutes Total delay

Managed Lane

NOTES:

Delays approaching the 6th Street off-ramps have not been calculated. Delays approach the 5th Street off-ramps have been estimated based on Information collected by AECOM for FCMS Phase 2 from April 2016

* Transit person throughput based on direct outputs from SF-CHAMP Model

Last updated: March 14, 2018

GP Lane Delay Estimates

SOUTHBOUND 280

Managed Lane: 6th St On to Pennsylvania Av On to US-101 S Off

AM peak hour

	2020 No-Build					2020 HOV2+ Convert Option 4						2020 HOV3+ Convert					2020 HOT Convert					
	Driving Person Throughput	Transit Person Throughput*	Shuttle Bus Person Throughput*	Total Person Throughput	Delay	Driving Person Throughput	Transit Person Throughput*	Shuttle Bus Person Throughput*	Total Person Throughput & % Change from NB		Delay	Driving Person Throughput	Transit Person Throughput*	Total Person Throughput & % Change from NB		Delay	Driving Person Throughput	Transit Person Throughput*	Shuttle Bus Person Throughput*	Total Person Throughput & % Change from NB		Delay
6th St On																						
6th St On to 18th St Off																						
18th St Off																						
18th St Off to 18th St On	3175	0	461	3636		3686	61	461	4209			3354	62	3877			3188	59	461	3708		
18th St/Mariposa St On										+16%					+7%						+2%	
18th St On to Pennsylvania Av Off																						
Pennsylvania Av Off																						
Pennsylvania Av Off to Pennsylvania Av On																						
Pennsylvania Av On																						
Pennsylvania Av On to US-101 S Off																						
US-101 S Off																						
US-101 S Off to US-101 S On																						
US-101 S On																						
US-101 S On to US-101 N On																						
US-101 N On																						
US-101 N On to Alemany Bl Off																						
Alemany Bl Off																						
Alemany Bl Off to Alemany Bl On																						
Alemany Bl On																						
Alemany Bl On to Monterey Bl Off																						
Monterey Bl Off																						
Monterey Bl Off to San Jose Av On																						
San Jose Av On																						
San Jose Av On to Ocean Av Off																						
Ocean Av Off																						
Ocean Av Off to Ocean Av On																						
					0.0 minutes Total delay						0.0 minutes Total delay					0.0 minutes Total delay						0.0 minutes Total delay

PM peak hour

	2020 No-Build					2020 HOV2+ Convert Option 4						2020 HOV3+ Convert						2020 HOT Convert					
	Driving Person Throughput	Transit Ridership (Model)	Transit Ridership (Model)	Total Person Throughput	Delay	Driving Person Throughput	Transit Person Throughput*	Shuttle Bus Person Throughput*	Total Person Throughput & % Change from NB		Delay	Driving Person Throughput	Transit Person Throughput*	Shuttle Bus Person Throughput*	Total Person Throughput & % Change from NB		Delay	Driving Person Throughput	Transit Person Throughput*	Shuttle Bus Person Throughput*	Total Person Throughput & % Change from NB		Delay
6th St On																							
6th St On to 18th St Off																							
18th St Off																							
18th St Off to 18th St On	3912	0	0	3912		4250	1332	0	5582			3289	1370	0	4659			4368	1218	0	5586		
18th St/Mariposa St On										+43%						+19%						+43%	
18th St On to Pennsylvania Av Off																							
Pennsylvania Av Off																							
Pennsylvania Av Off to Pennsylvania Av On																							
Pennsylvania Av On																							
Pennsylvania Av On to US-101 S Off											4.3						6.2						0.7
US-101 S Off																							
US-101 S Off to US-101 S On																							
US-101 S On																							
US-101 S On to US-101 N On																							
US-101 N On																							
US-101 N On to Alemany Bl Off																							
Alemany Bl Off																							
Alemany Bl Off to Alemany Bl On																							
Alemany Bl On																							
Alemany Bl On to Monterey Bl Off					5.7						2.0						1.2						3.3
Monterey Bl Off																							
Monterey Bl Off to San Jose Av On																							
San Jose Av On																							
San Jose Av On to Ocean Av Off																							
Ocean Av Off																							
Ocean Av Off to Ocean Av On																							
					5.7 minutes Total delay						6.3 minutes Total delay						7.4 minutes Total delay						4.0 minutes Total delay

NOTES:
* Transit person throughput based on direct outputs from SF-CHAMP Model
Last updated: March 14, 2018

Managed Lanes Travel Time Savings

Scenario			GP Delay Within Study Area* (min)	Managed Lanes TT Savings Within Study Area (min) (traveling SB on I-280 from SF)	Managed Lanes TT Savings Within Study Area (min)
US-101 NB	AM	NB	**8.0**		-
		HOV 2+	**7.0**		2.0
		HOV 3+	**7.0**		2.0
		HOT	**7.0**		2.0
	PM	NB	6.2		-
		HOV 2+	10.6		10.6
		HOV 3+	**13.1**		13.1
		HOT	9.0		9.0
US-101 SB	AM	NB	5.7	-	-
		HOV 2+	8.3	8.3	7.0
		HOV 3+	16	16	7.0
		HOT	9.8	9.8	7.0
	PM	NB	0	-	0
		HOV 2+	1.2	1.2	1.2
		HOV 3+	**11.1**	11.1	9.7
		HOT	0	0	0
I-280 NB	AM	NB	13.1		-
		HOV 2+	10.6		3.1
		HOV 3+	9.5		3.1
		HOT	12.1		2.2
	PM	NB	3.7		-
		HOV 2+	2.1		1.0
		HOV 3+	1.7		1.3
		HOT	2.9		1.2
I-280 SB	AM	NB	0		-
		HOV 2+	0		0
		HOV 3+	0		0
		HOT	0		0
	PM	NB	5.7		-
		HOV 2+	2		-
			4.3		4.3
		HOV 3+	1.2		-
			6.2		6.2
		HOT	3.3		-
			0.7		0.7

* US-101 Northbound Study Area is north of the I-380 On-Ramp

Travel Time Estimates

Segment / Scenario			Distance (mi)	Managed Lanes Travel Time Savings Within Study Area* (min)	HOV Travel Time (min)	GP Travel Time (min)
US-101 NB I-380 to County line	AM	NB	5.1	-	-	7.6
		HOV 2+	5.1	2.0	5.6	7.6
		HOV 3+	5.1	2.0	5.6	7.6
		HOT	5.1	2.0	5.6	7.6
	PM	NB	5.1	-	-	11.8
		HOV 2+	5.1	10.6	5.6	16.2
		HOV 3+	5.1	13.1	5.6	18.7
		HOT	5.1	9.0	5.6	14.6
US-101/I-280 NB County line to Downtown (5th & King) *includes delays at King Street (added to both HOV and GP lanes)*	AM	NB	5.0	-	-	16.3
		HOV 2+	5.0	3.1	11.1	14.2
		HOV 3+	5.0	3.1	11.0	14.1
		HOT	5.0	2.2	11.3	13.5
	PM	NB	5.0	-	-	8.4
		HOV 2+	5.0	1.0	5.9	6.9
		HOV 3+	5.0	1.3	5.9	7.1
		HOT	5.0	1.2	6.1	7.3
US-101/I-280 SB Downtown (6th Street) to County Line	AM	NB	5.0	-	-	11.2
		HOV 2+	5.0	8.3	5.5	13.8
		HOV 3+	5.0	16.0	5.5	21.5
		HOT	5.0	9.8	5.5	15.3
	PM	NB	5.0		-	9.2
		HOV 2+	5.0	4.3	5.5	9.8
		HOV 3+	5.0	11.5	5.5	17.0
		HOT	5.0	0.7	5.5	6.2
US-101 SB County Line to I-380	AM	NB	5.1	-	-	5.6
		HOV 2+	5.1	0.0	5.6	5.6
		HOV 3+	5.1	0.0	5.6	5.6
		HOT	5.1	0.0	5.6	5.6
	PM	NB	5.1	-	-	5.6
		HOV 2+	5.1	1.2	5.6	6.8
		HOV 3+	5.1	5.8	5.6	11.4
		HOT	5.1	0.0	5.6	5.6