CITY OF MOUNTAIN VIEW

SHORELINE BOULEVARD CORRIDOR STUDY

NOVEMBER 2014

NELSON NYGAARD

In association with:

Flint Strategies | Freedman Tung + Sasaki | Lea+Elliott
Mark Thomas & Company, Inc. | TJKM Transportation Consultants

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EXECUTIVE SUMMARY

In recent years the City of Mountain View and its community members have undertaken an ambitious effort to rethink how the greater Shoreline Boulevard corridor functions and to prioritize the safe and convenient travel of transit riders, bicyclists, and pedestrians. The Shoreline Boulevard Corridor Study is the first tangible step towards achieving this vision. It is the culmination of a year-long community planning process. It proposes a package of multimodal projects, streetscape changes, and operational improvements that will transform how people travel in the greater Shoreline Boulevard corridor.

PLANNING CONTEXT

The Shoreline Boulevard Corridor Study was informed by a number of city plans, policy documents, and guidelines. Specific recommendations and corridor alternatives were developed within the context of a comprehensive city framework that prioritizes safe, convenient, and accessible travel for all travel modes. Key planning documents and guidelines include:

- 2030 General Plan
- 2013 Shoreline Transportation Study
- North Bayshore Precise Plan
- Bicycle Transportation Plan
- Pedestrian Master Plan

Peak period congestion on Shoreline Boulevard.

EXISTING CONDITIONS AND OUTREACH

KEY FINDINGS

The existing conditions analysis yielded a number of key findings, which guided the development of alternatives and recommendations. Traffic congestion is a significant concern, particularly along Shoreline Boulevard, which is already at capacity during peak periods. The level of congestion impacts access to and from North Bayshore, especially for transit vehicles traveling to or from the Mountain View Transit Center during peak periods.

There are a wide variety of transit services within the greater Shoreline Boulevard corridor, downtown, and North Bayshore areas. Transit options include Caltrain, light rail, bus, and shuttle services from both the public and private sector. Mountain View has the third highest ridership in the Caltrain system, and, given its location and level of service, Mountain View has become one of the most important stops for last-mile shuttle service. While there are many transit services, not all of them are available to all potential riders. In addition, many of the shuttle services are redundant and serve similar markets.

The Transit Center was not designed to accommodate such loading activity. The volume of vehicles is impacting operations of the facility and the surrounding streets. Observations indicate that more than 200 public and private buses and shuttles are using the Transit Center during just the peak periods.

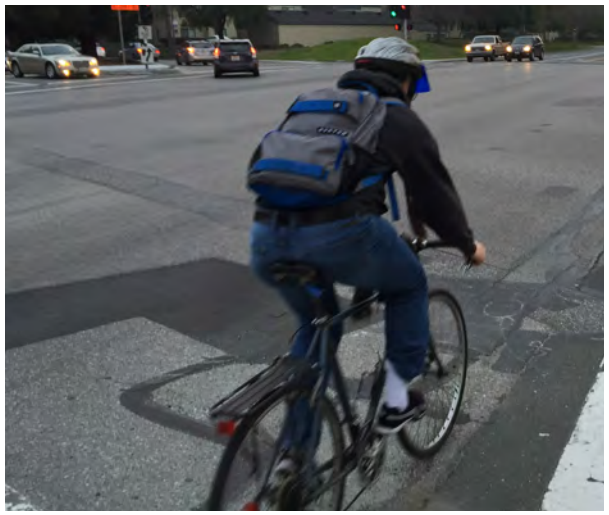
Pedestrian activity and bicycle ridership is also an increasingly important mode of travel in the area. Shoreline Boulevard is technically walkable and bikeable, yet fast traffic dominates the street environment. Bicycle lanes, where they exist, are narrow and directly abut vehicle traffic. Sidewalks are narrow and adjacent to uninviting streetscapes. Ultimately, the street network is defined by its vehicle-oriented design, which has limited the attractiveness of biking, walking, and transit as viable modes of travel. Major barriers, such as Central Expressway and U.S. Route 101, also present both a physical and psychological obstacle.

Shuttle loading during the morning commute rush.

COMMUNITY OUTREACH PROGRAM

This study included a comprehensive outreach program to capture input from the larger Shoreline Boulevard and North Bayshore community, as well as key regional stakeholders. The input was used to confirm and refine a cohesive corridor vision, as well as provide input at key stages in the project to guide the development of alternatives and final recommendations. The major components of the outreach program included:

- Project website (www.shorelinecorridor.com) and project-specific collateral
- Eblasts and press releases
- Community survey
- Mobile workshops
- Three public and stakeholder workshops
- More than a dozen individual meetings with regional agencies and community groups
- Three presentations to City Council



Existing infrastructure on Shoreline Boulevard does not facilitate biking for all ages and abilities.

PACKAGE OF RECOMMENDATIONS

The preferred package of corridor improvements is expected to provide optimal benefits in terms of multi-modal mobility, safety, convenience, and urban design within the Shoreline Boulevard Corridor (Figure ES-1).

FIGURE ES-1 SUMMARY OF CORRIDOR IMPROVEMENTS

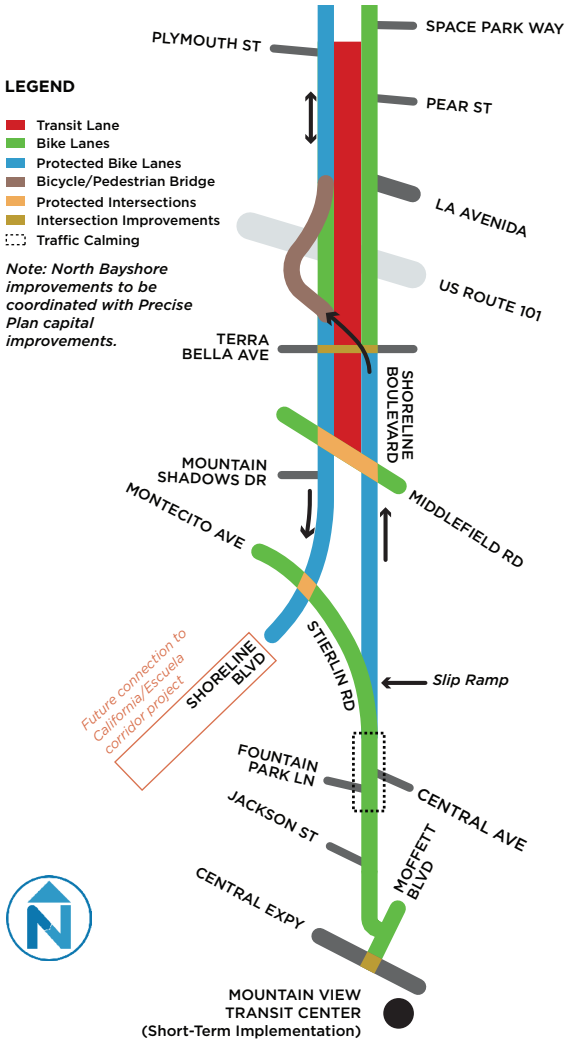


Figure ES-1 provides an overview of the preferred package of corridor improvements. It highlights the core components of the recommendations and their location.

U.S. ROUTE 101 - BICYCLE AND PEDESTRIAN BRIDGE

U.S. Route 101 presents a major challenge for multi-modal travel in the Shoreline Boulevard corridor. The existing overpass provides minimal accommodation for bicyclists and pedestrians, and the high vehicle speeds and challenging crossings largely deter travel on bike or by foot.. A dedicated pedestrian and bicycle bridge is needed to significantly improve safety, make Shoreline Boulevard a desired route, and attract bicyclists and pedestrians of all ages and abilities.

The proposed bridge would provide two seven-foot lanes for bicyclists and a six-foot lane for pedestrians (20 feet total width). These widths should provide adequate space for bicyclists to pass and a comfortable walking environment for pedestrians. On both sides of U.S. Route 101 the bridge touch down and then transition into a two-way protected bicycle lane on the west side of Shoreline Boulevard. The specific type and design of the bridge would be determined in the next project phase, but initial ideas range from a basic clear span bridge to a specialty suspension bridge.

The Mary Avenue bridge is one example for Mountain View.
Image from Flickr, Naotake Murayama

SHORELINE BOULEVARD — DEDICATED TRANSIT LANE

A prominent feature of the proposed improvements to Shoreline Boulevard is the center-running, reversible transit lane extending from Middlefield Road north to Plymouth/Space Park Way in North Bayshore. The lane would be used by northbound buses on weekday mornings and by southbound buses on weekday afternoons. It would feature median and curb-side stops at Terra Bella Avenue and Pear Avenue. In addition to North Bayshore transit service, regular VTA routes and other shuttle services would be eligible to use the lane, as well as emergency vehicles. Key design features include:

- **Dedicated transit signals** at Middlefield Road and Plymouth Street to facilitate transitions in and out of the transit lane.
- **Physical barriers** to prevent vehicles from entering into the lane.
- **Pavement markings and high-visibility signage** to delineate the lane and mitigate conflict points.
- **A "clearing" period** would be required prior to the shift in direction to ensure that all vehicles have exited the lane.
- **Maintenance and emergency vehicles** would be able to utilize the lane as needed, but automobiles (including carpools or vanpools) would be prohibited at all times.

SHORELINE BOULEVARD — PROTECTED BICYCLE LANES

This project proposes the first protected bicycle lanes in Mountain View. Protected bicycle lanes, or cycle tracks, are one of the most crucial infrastructure investments a city can make to increase bicycle ridership. They are preferred by all types of bicyclists because they create a physical buffer from vehicle traffic, thereby significantly improving a bicyclist's level of comfort. Protected bicycle lanes also improve safety, reduce conflicts with vehicles, improve streetscape design and aesthetics, and contribute to improved economic activity.

One-way protected bicycle lanes are proposed on Shoreline Boulevard from Stierlin Road/Montecito Avenue north into North Bayshore. At Terra Bella Avenue, the one-way facility would transition into a two-way facility along the west side of Shoreline Boulevard, connecting to the U.S. Route 101 bicycle and pedestrian bridge. North of U.S. Route 101, a two-way protected bicycle lane is proposed for the west side of Shoreline Boulevard north to Charleston Road.

The proposed design for the one-way facility includes a 6.5 foot lane meeting the minimum standard to ensure adequate room for passing bicyclists. Adjacent to the bicycle lane is a 6-foot buffer, providing substantial physical separation from the fast-moving vehicle traffic on Shoreline Boulevard and creating space for a robust tree and landscaping plan. The proposed design for the two-way facility is two 6.5 foot lanes with a substantial buffer between vehicle lanes on Shoreline Boulevard.

On Shoreline Boulevard, there are a large number of driveways that cannot be closed because vehicle access must be maintained. This creates concern for potential conflict with vehicles turning into and out of driveways and across the protected bicycle lane. The conceptual designs for the protected bicycle lanes include high-visibility signage and pavement markings that have been proven to mitigate these conflicts by establishing priority for bicyclists.

A one-way protected bicycle lane, such as this one in Temple City, is proposed for Shoreline Boulevard.
Image from Joe Linton, Streetsblog.

SHORELINE BOULEVARD — PROTECTED INTERSECTIONS

Intersections are the most dangerous place for bicyclists and pedestrians because the myriad of turning movements creates many potential conflict points. Intersections are particularly challenging with protected bicycle lanes, as the physical buffer must be dropped through the intersection. This plan proposes "protected" intersections[1] along Shoreline Boulevard at Middlefield Road and at Stierlin Road/Montecito Avenue. Key components of the protected intersection design include:

- **A separate signal phase for bicycles and "No Right on Red,"** which provides a leading interval for bicycles and pedestrians and mitigates right-turn conflicts
- **Designated and distinct crossing zones** for bicyclists and pedestrians, which require crosswalks to be moved back from the intersection
- **High-visibility crosswalks and pavement markings** to clearly define space for pedestrians and bicyclists
- **Advance stop lines** to position bicyclists in front of motorists and make them more visible
- **Corner refuge islands** offset from the corners of the intersection to provide a protected space for bicyclists and increase visibility of bicyclists for motorists

1 This design concept is also known as a "Dutch" intersection, and has been further developed and advocated for in the American context by Nick Falbo.

STIERLIN ROAD — BICYCLE LANES

Stierlin Road is a key connection between the Transit Center and Shoreline Boulevard. To facilitate bicycle and pedestrian access, the Stierlin Road slip lane would be reconfigured to provide a northbound, one-way protected bicycle lane. The bicycle lane would be 6.5 feet wide with an adjacent 2.5-foot raised buffer. Further south, Class II bicycle lanes would be implemented on Stierlin Road. The lanes would be six feet in width and would require the removal of existing on-street parking along the east side of Stierlin Road to accommodate the lanes within the existing right-of-way. Traffic calming elements would also be installed on Stierlin Road to reduce vehicle speeds and improve safety for all users.

New bicycle lanes on Stierlin Road would provide a direct connection to the Transit Center.

CENTRAL EXPRESSWAY/CASTRO STREET/MOFFETT BOULEVARD

The intersection of Central Expressway/Moffett Boulevard/Castro Street poses a significant barrier to travel in the corridor. The complexity of the movements at the intersection, high vehicle volumes, and need for signal phasing that must safely accommodate the passage of Caltrain trains are all factors that contribute to limited accommodations for bicyclists and pedestrians. The proposed improvements for this intersection include:

- **Reconfiguration of Castro Street** to eliminate the left-turn lanes onto westbound Central Expressway, allowing for additional pedestrian crossing time, improved clearing of Caltrain tracks, and creation of a designated bike lane on this portion of Castro Street
- **Closure of the right turn slip lanes**, creating additional pedestrian refuge space and slowing vehicle turning speeds
- Further evaluation of **allocating additional crossing time** on Central Expressway for pedestrians and bicyclists
- **High-visibility crosswalks** to increase visibility of pedestrians
- **Bicycle markings and signage** to better facilitate movement of bicyclists through the intersection
- Assessment of long-term potential for a transit stop along Central Expressway, as well as **grade separation** of the intersection

MOUNTAIN VIEW TRANSIT CENTER

In recent years, the importance of the Transit Center has grown substantially, largely because it has Baby Bullet service and is a regional hub for Silicon Valley employer shuttles. It is also a unique station because it serves as the northern anchor for the downtown commercial core. The Transit Center has outgrown its design and is increasingly constrained by the growth in transit riders and shuttle loading.

The short-term recommendations for the Transit Center include pedestrian circulation improvements, relocation of private shuttle pick-up/drop-off locations, and additional station amenities. A particular focus is the relocation of private shuttle services to Hope and View Streets and prioritization of the transit loading bays for VTA, public, TMA, and North Bayshore vehicles during the morning peak period. Additional bicycle parking, bike share pods, and the installation of a staffed bike station would increase bicycle access and help to mitigate bicycle capacity constraints on Caltrain. Within the parking lot, a new "kiss-n-ride" area is proposed for the peak periods to improve passenger loading and minimize circulation impacts.

The City and its regional partners recognize that there are significant longer-term challenges facing the greater station area. Increased rail service and usage will necessitate a reevaluation of the Transit Center's purpose and role in the local and regional transportation system. As a result, it is recommended that a comprehensive Transit Center master plan for the Caltrain Station and surrounding area be developed. The master plan would address questions related to grade separation, Caltrain platform improvements, shuttle loading capacity constraints, enhanced bicycle and pedestrian access, development of additional parking supply, and potential redevelopment of the Caltrain parking lot.

TRANSIT SERVICE PLAN

The existing public and private transit network will require expansion to meet the needs of future employment growth. At the same time, physical constraints limits the amount of service that can be provided. The transit service plan articulates a vision for a consolidated shuttle system that would be open to the public. It is flexible in its design in order to integrate and build upon recent services initiated by the Mountain View Transportation Management Association (TMA).

The suggested service plan consists of four routes: a "trunk" or main line and three "branch" routes. Stops on the trunk route would be within one-quarter to one-third of a mile of nearly all North Bayshore destinations, while branch routes would provide more direct service to those destinations that are some distance from the trunk route. The service plan assumes that the service would be free and open to the public and utilize low-emission vehicles.

Long-term challenges related to station capacity and grade separation would be addressed with a Transit Center Master Plan.

IMPLEMENTATION PLAN

The estimated cost for all proposed improvements is approximately $41 million, including the initial phase of the median transit lane. The cost estimates (Figure ES-2) do not include right-of-way acquisition, but do include contingencies for project design and engineering, city administration, utilities, construction support, right-of-way evaluation, and other minor items.

Full implementation of the complete package of corridor improvements will take time. Designs need to be further refined and developed, and several issues require additional study. Nevertheless, the City has prioritized multimodal improvements to the Shoreline Boulevard corridor and seeks to implement various aspects of the recommendations as soon as possible. Therefore, a phased implementation plan (Figure ES-3) is proposed, but should be adjusted over time as conditions evolve and funding becomes available.

FIGURE ES-2 SUMMARY OF ESTIMATED PROJECT COSTS

Project Segment	Estimated Cost (2014 Dollars)
Transit Center Short-term Improvements	$326,000
Central Expressway/Moffett Boulevard/Castro Street Intersection	$1,630,000
Stierlin Road: Bike Lanes + Traffic Calming Elements	$1,200,000
Shoreline Boulevard: Stierlin/Montecito to Middlefield Road	$6,120,000
Shoreline Boulevard/Middlefield Road Intersection	$1,730,000
Shoreline Boulevard: Middlefield Road to Caltrans Right-of-Way	$6,440,000
Improvements in Caltrans Right-of-Way	
Bicycle/Pedestrian Bridge	$13,530,000
Other Improvements	$2,550,000
Median Bus Lane (Initial Phase)	$2,280,000
Median Bus Lane (Initial Phase outside Caltrans Right-of-Way)	$2,670,000
Shoreline Boulevard (b/t Bicycle/Pedestrian Bridge and Plymouth Street/Space Park Way)*	$2,610,000
TOTAL	$41,086,000

* Cost estimates for these and other improvements located further north along the corridor are included in the North Bayshore Precise Plan transportation improvement program.

FIGURE ES-3 SUMMARY OF PROJECT PHASING

Segment	Proposed Improvements	Short-term (0 to 3 years)	Medium-term (3 to 6 years)
Shoreline Boulevard	**Shoreline Boulevard - Transit Lane (Initial Phase).** Includes conversion of median and center lane between Middlefield Road and Plymouth Street or Space Park Way, pavement markings and striping, vertical/horizontal separation, transit priority signalization, and closure of the access ramp to State Route-85 from northbound Shoreline Boulevard. Transit stops and full landscaped buffers would be deferred.	X	
	Shoreline Boulevard - Interim Bicycle Lane Enhancements (including U.S. Route 101 Overcrossing). Includes restriping to narrow travel lanes and widen bicycle lanes, plus pavement markings/signage at key locations. Options could also include a striped buffer and flexible bollards.	X	
	Shoreline Boulevard - Complete Protected Bicycle Lanes. Includes landscaped buffers, driveway treatments, pavements markings, and signage (Stierlin Road to Plymouth Street).		X
	Shoreline Boulevard - Complete Median Transit Lane. Includes landscaped buffers (Middlefield Road to Plymouth Street/Space Park Way) and transit stops at Terra Bella Avenue and Pear Avenue.		X
	Shoreline Boulevard/Middlefield Road Protected Intersection Improvements.	X	
	Shoreline Boulevard/Stierlin Road/Montecito Avenue Protected Intersection Improvements.		X
	Shoreline Boulevard/Terra Bella Avenue Intersection Improvements.		X
	Shoreline Boulevard. Additional marked pedestrian crossing (between Stierlin Road/Montecito Avenue and Middlefield Road) and pedestrian realm improvements (sidewalk widening, enhanced lighting, and streetscape elements).		X
Bicycle/Pedestrian Bridge	**Bicycle and Pedestrian Bridge.** Includes two-way protected bicycle lanes on west side of Shoreline Boulevard.		X
Middlefield Road	**Middlefield Road Bicycle Lane Enhancements.** Includes restriping to narrow travel lanes and widen bicycle lanes, and addition of pavement markings/signage at key locations. Options could also include a striped buffer and/or physical separation.	X	
Stierlin Road	**Stierlin Road Slip Lane.** Includes vehicle travel lane, northbound protected bicycle lane, and driveway/crossing treatments.	X	
	Stierlin Road. Includes restriping to add bicycle lanes, narrow travel lanes, and installation of traffic calming measures.	X	
Central Expressway / Moffett Boulevard / Castro Street	**Castro Street/Moffett Boulevard/Central Expressway Intersection Improvements.** Includes reconfiguration of Castro Street approach plus signal timing changes, bike pavement markings, high-visibility crosswalks, and corner bulb-outs.	X	
Transit Center	**Transit Center Shuttle Management.** Includes enhanced management of bus center and new loading zones on Hope Street and/or View Street.	X	
	Transit Center Access Improvements. Includes new pedestrian access points, high-visibility crosswalks, additional bicycle parking and bicycle share pods, Kiss-n-Ride area improvements, car sharing, and passenger information.	X	
	Transit Center Master Plan. Includes long-term planning process to address station capacity, grade separation, additional bicycle and pedestrian access improvements, parking structure, and transit-oriented development.	X	
Transit Service	**Public Transit Service Plan (Initial).** Includes peak-period service and/or integration with short-term TMA service.	X	
	Public Transit Service Plan (Full). Includes all-day service.		X

CHAPTER 1
INTRODUCTION

The City of Mountain View is faced with the challenge of managing employment growth in a manner that preserves the city as a great place to live, work, and visit. Nowhere are these pressures more evident than in the North Bayshore area. Already home to one of the biggest employment centers in the Bay Area, this area is identified in the 2030 General Plan as a key location to not only expand employment, but also foster change through a more diverse mix of land uses and sustainable development. Employment in this area is projected to increase by more than 40% by 2030.

The local and regional transportation network will not be able to accommodate projected growth based on current travel behaviors. Shoreline Boulevard is one of the most important corridors in the network, yet its vehicle-oriented design is becoming less effective at serving the transportation needs of all users. During peak commute periods, Shoreline Boulevard becomes heavily congested. Transit vehicles avoid the corridor altogether and utilize longer, more circuitous routes, which adds travel time and makes transit less attractive. Existing public and private transit services help to connect people to their jobs and reduce congestion in the area, but service is duplicative and poorly coordinated.

Bicyclista and pedestrians are discouraged from using Shoreline Boulevard because of a lack of safe facilities, of physical separation between bicycle lanes and high-speed traffic. Pedestrians must walk along uninviting streetscapes with poor connectivity. U.S. Route 101 is perhaps the biggest barrier, severely restricting bicycle and pedestrian access to and from North Bayshore. As the City of Mountain View grows and evolves so must the Shoreline Boulevard corridor.

Shoreline Boulevard is a key travel corridor for motorists, transit, vehicles, bicyclists, and pedestrians.

The City recognizes these mobility challenges and has called for a dramatic shift in travel behaviors. The *Shoreline Transportation Study* (2013) and the *North Bayshore Precise Plan* (2014) call for a significant reduction in trips made by single-occupancy vehicles (SOV). The City Council endorsed commute mode share targets for North Bayshore in March 2013 (Figure 1-1), which are now embedded in the *North Bayshore Precise Plan*.

To meet these targets, the City and community articulated an ambitious agenda to rethink how the greater Shoreline Boulevard corridor functions and prioritize the safe and convenient travel of transit riders, bicyclists, and pedestrians.

The *Shoreline Boulevard Corridor Study* is the first tangible step towards achieving this vision. It is the culmination of a year-long community planning process. It proposes a package of multimodal projects, streetscape enhancements, and operational improvements that will transform how people travel in the greater Shoreline Boulevard corridor. The package offers improvements for all users:

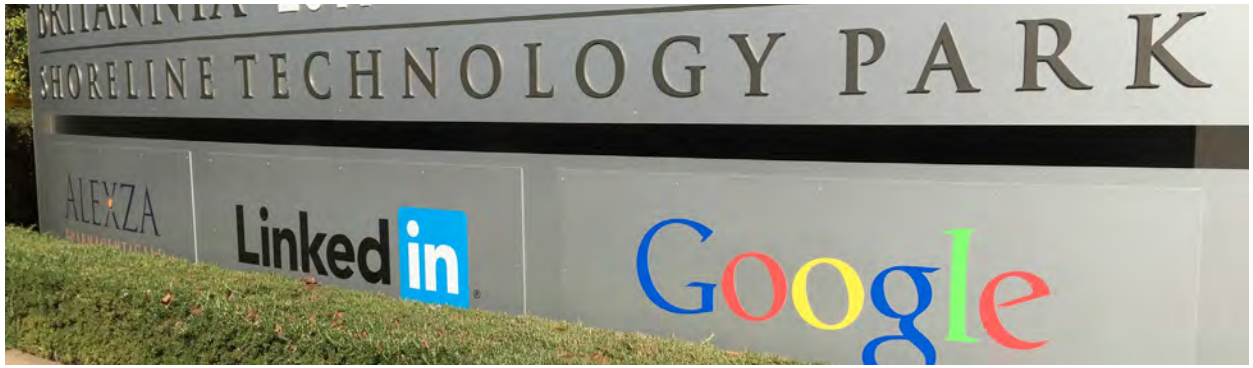
- Bicyclists of all ages and abilities will be able to utilize **physically separated bicycle lanes** to directly travel between downtown, the Mountain View Transit Center (Transit Center), and North Bayshore.
- A new **pedestrian and bicycle bridge** will provide an improved connection across U.S. Route 101.
- **Traffic calming measures** will reduce vehicle speeds, improve safety, and create more people-oriented places.
- Buses and shuttles will be able to bypass the most congested areas on Shoreline Boulevard by utilizing a **transit-only lane**, thereby saving passengers significant travel time.
- A **new public transit system** will make travel faster and more seamless, directly connecting job centers and housing with the Transit Center.
- **Passenger loading at the Transit Center will be streamlined**, reducing traffic and loading impacts on the surrounding streets.
- Walking will become a more desirable mode of travel, as **new streetscape amenities and intersection improvements** will make streets safer and more attractive.
- Transportation improvements will incorporate **high-quality streetscape elements**, fostering a strong sense of place and reinforcing local character.

Shoreline Boulevard has evolved to the place it is today by designing primarily for vehicles, while offering minimal accommodations for transit, bicycles, and pedestrians. People have become accustomed to the corridor as it exists now, but few would call it an ideal street that is able to effectively serve commuters or families wishing to take their kids for a bike ride.

This plan offers a new vision for the current auto-dominated Shoreline Boulevard corridor. It is a vision that transforms Shoreline Boulevard and Stierlin Road into truly multimodal corridors. The automobile will still play a central role, but the street will also provide a safe, convenient, and inviting place for all users. If implemented, the proposed bicycle and transit facilities would set a precedent not just for Mountain View, but for the Bay Area as a whole. Change of this degree will not be easy to achieve. It is ambitious and challenging, but so are the transportation challenges facing the City.

FIGURE 1-1 NORTH BAYSHORE COMMUTE MODE SHARE TARGETS

Travel Mode	Commute Mode Share Target
Ridesharing *(Carpools & Vanpools)*	10%
Active Transportation *(Biking & Walking)*	10%
Transit *(Public & Private Services)*	35%
Single-Occupant Vehicle	45%



The North Bayshore area is one of the largest employment centers in the Bay Area.

Central Expressway and Stierlin Road are primary gateways between Downtown and North Bayshore.

STUDY AREA

The study area is generally defined as extending from the Transit Center and the surrounding downtown streets north along Stierlin Road and Shoreline Boulevard (north of Stierlin and Montecito Avenue), across U.S. Route 101 and into North Bayshore. The northern limit of the study area is Plymouth Avenue. While the primary focus is Stierlin Road and Shoreline Boulevard, the study does consider the larger street network to ensure proper connections and linkages. Key study intersections are shown in Figure 1-2.

PROJECT GOALS AND OBJECTIVES

The primary goal of the study is to create transit, bicycle, and pedestrian strategies that will address current mobility challenges and mitigate the anticipated impacts of employment growth in North Bayshore. The planning process for this study was guided by a set of simple and concise objectives. These include:

Connectivity: Improve mobility connections between the Transit Station and the North Bayshore area.

Accessibility: Develop multimodal design solutions to overcome major physical barriers.

Safety: Enhance safety for all users, but especially pedestrians and bicyclists.

Coordination: Better coordinate local transit services.

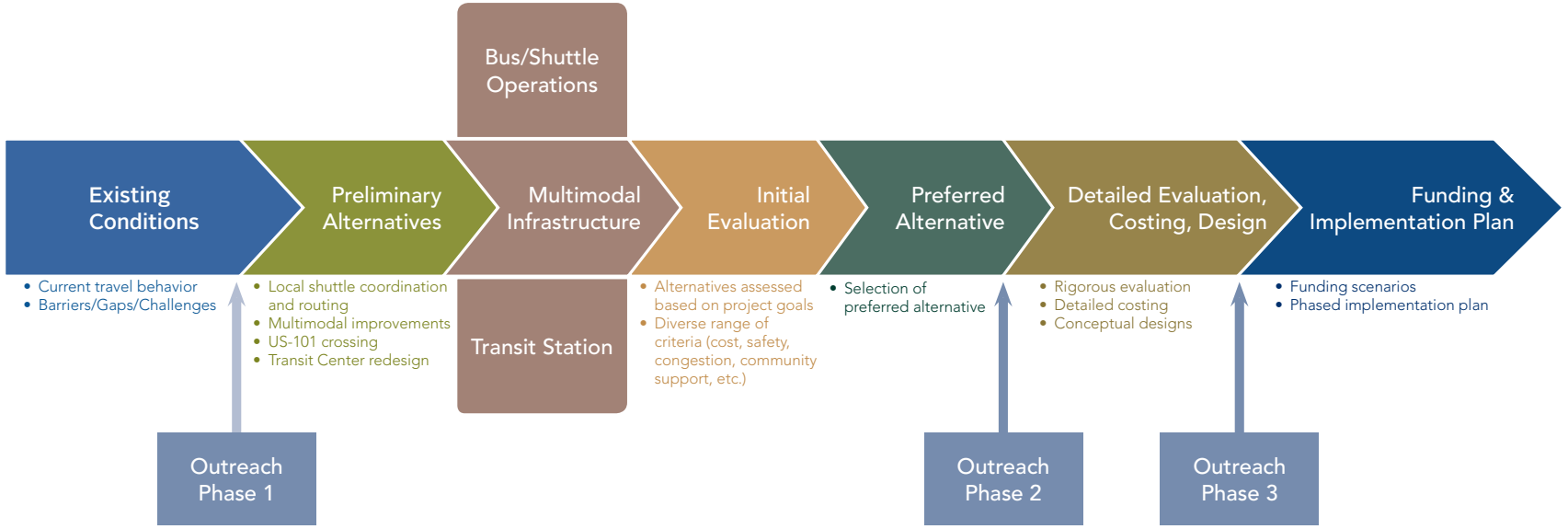
Collaboration: Create an inclusive outreach process involving all local and regional stakeholders.

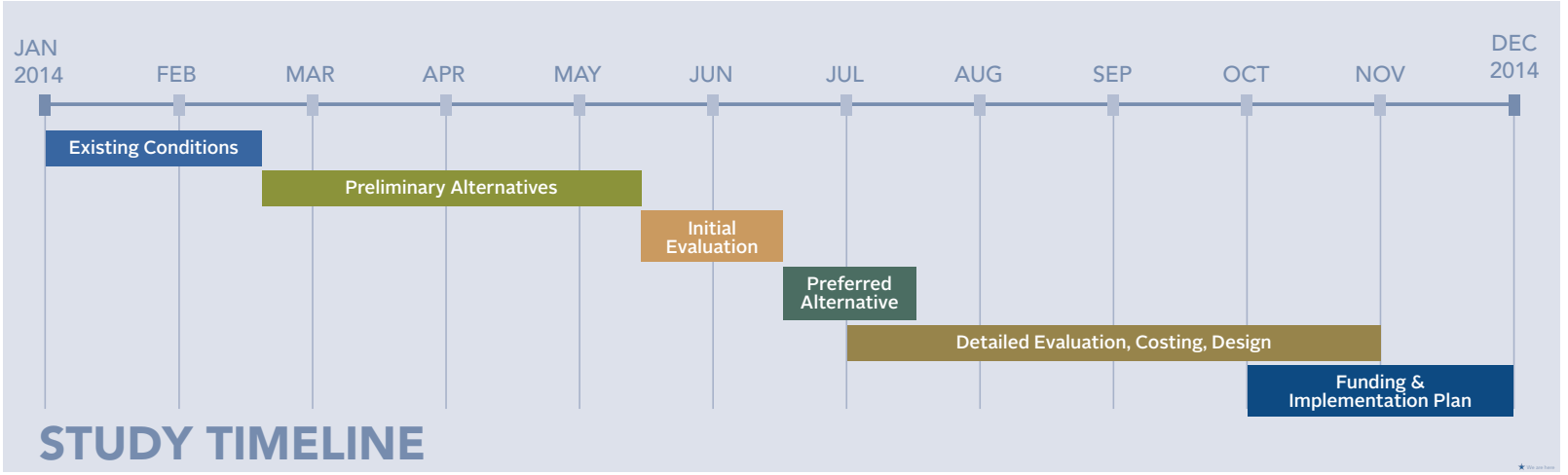
FIGURE 1-2 SHORELINE BOULEVARD CORRIDOR STUDY AREA

STUDY PROCESS

Figure 1-3 summarizes the study process that took place throughout 2014. Three rounds of community outreach were conducted at key stages of the planning process: existing conditions assessment, development of draft alternatives, and refinement of the preferred alternative. The City Council was also consulted throughout the planning effort at similar points in the study. This final report summarizes all of the analysis work performed during the study, and includes conceptual designs for proposed recommendations, as well as an an implementation plan to move the proposed projects into detailed engineering, environmental review, and construction.

FIGURE 1-3 STUDY PROCESS AND TIMELINE





Shoreline Boulevard Corridor Study
City of Mountain View

REPORT STRUCTURE

Chapter 2 describes the plans, studies, guidelines, and policies that guide the planning process for this study.

Chapter 3 summarizes the key findings from the existing conditions analysis and provides an overview of the project's community outreach program.

Chapter 4 describes the preferred package of improvements, including a summary of the proposed concepts for transit, bicycle, and pedestrian infrastructure along Shoreline Boulevard and Stierlin Road, as well as at the key intersection of Central Expressway/Moffett Boulevard/Castro Street.

Chapter 5 summarizes the proposed short-term improvements for operation of the Transit Center and outlines a process for addressing long-term challenges related to station capacity and access.

Chapter 6 describes the proposed public transit service plan designed to consolidate existing shuttles, improve public mobility, and reduce single-occupancy vehicle trips.

Chapter 7 includes planning-level cost estimates for the various project elements, outlines a phased implementation plan, and summarizes potential funding sources.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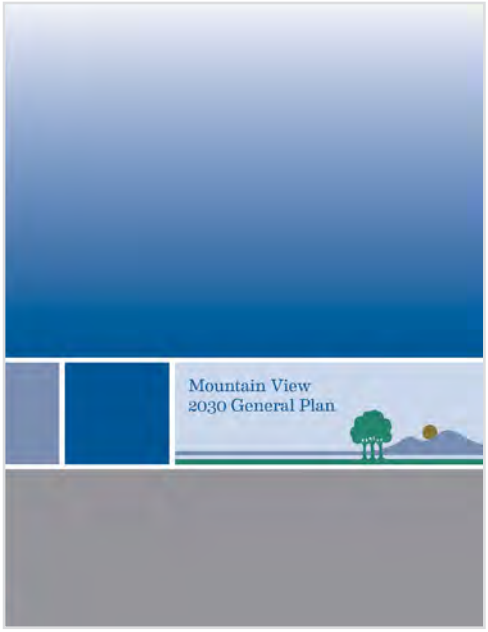
CHAPTER 2

PLANNING CONTEXT

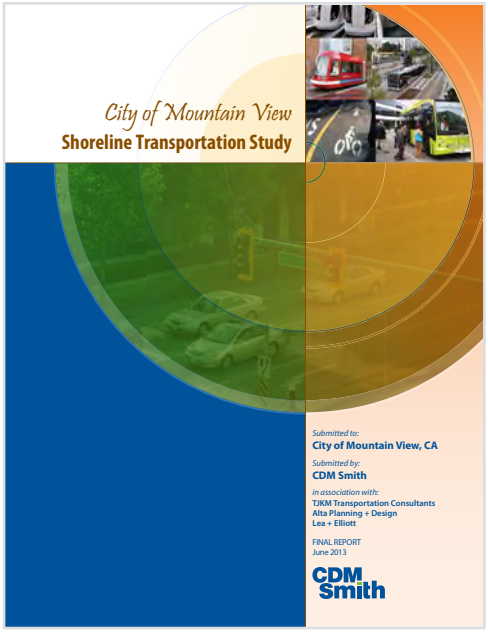
The Shoreline Boulevard Corridor Study was informed by a number of city plans, policy documents, and guidelines. Specific recommendations and corridor alternatives were developed within the context of a comprehensive city framework that prioritizes safe, convenient, and accessible travel for all travel modes. Similarly, the preferred alternatives described in Chapters 4-6 will be used to support long-term development within the Shoreline Boulevard corridor and North Bayshore. The strategies are designed to establish a strong precedent for investment in transit, bicycling, and walking throughout Mountain View.



2030 GENERAL PLAN

The 2030 General Plan, adopted in July 2012, is a comprehensive update to the City's 1992 General Plan. The Plan provides a series of goals, policies and actions that will help guide development and planning efforts over the next 20 years. The 2030 General Plan emphasizes the importance of improving access for all modes of transportation and increasing the non-auto mode share through mobility-related goals. The Shoreline Boulevard study area falls within four of the city's seven planning areas, including: North Bayshore, Monta Loma/Farley/Rock, Moffett/Whisman, and Central/Downtown. North Bayshore is defined as "change area," which set in motion the development of the North Bayshore Precise Plan.

The Shoreline Boulevard study area falls within four of the seven planning areas, including: North Bayshore, Monta Loma/Farley/Rock, Moffett/Whisman, and Central/Downtown.



2013 SHORELINE TRANSPORTATION STUDY

In 2013, the City of Mountain View completed the Shoreline Transportation Study. The study analyzed the impact of future employment growth on the transportation network for North Bayshore, with an emphasis on travel modes other than single-occupancy vehicles (SOV).

One conclusion from the study was the need for a substantial shift in mode share in order to accommodate the anticipated growth in North Bayshore. Commute mode share targets calling for a reduction in SOV trips to only 45% were approved by the City Council in March 2013 and included in the North Bayshore Precise Plan.

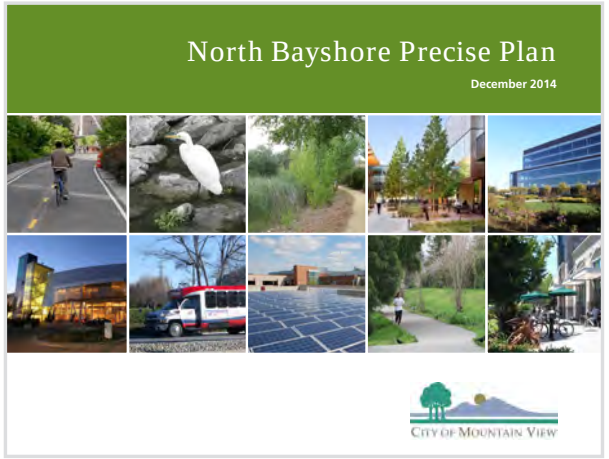
Guided by the future mode share goals, a series of transportation strategies were identified across all modes and travel markets. Key recommendations focused on reducing SOV travel and improving transit and bicycle access in the Shoreline Boulevard corridor through dedicated transit facilities, protected bicycle lanes, a new pedestrian and bicycle bridge over U.S. Route 101, and a consolidated shuttle network serving North Bayshore. The 2013 recommendations served as a starting point for the alternatives developed in this study.

NORTH BAYSHORE PRECISE PLAN

The 2030 General Plan defined the North Bayshore district as a "change area" that is expected to see growth and increased density as an employment center for the City. The North Bayshore district is envisioned to become a model for a highly sustainable, mixed-use campus environment with a focus on improved transportation options. The City of Mountain View adopted the Precise Plan for the North Bayshore district in December 2014, which builds on the goals and vision set forth in the 2030 General Plan, as well as the transportation recommendations developed as part of the Shoreline Transportation Study.

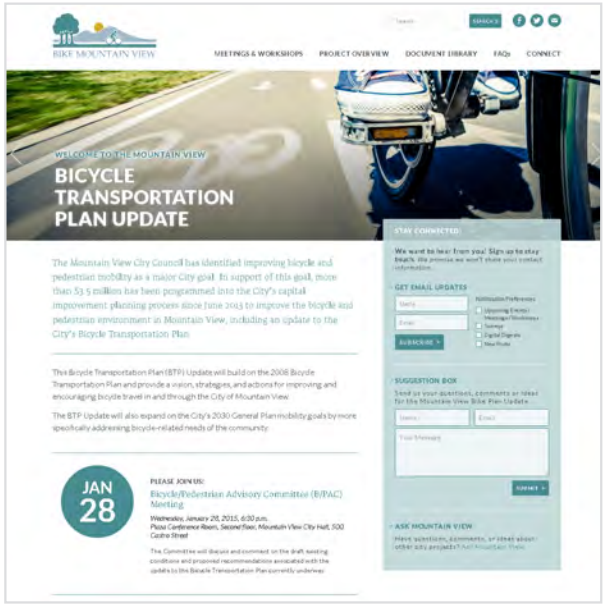
The North Bayshore Precise Plan includes a series of recommendations related to land use and development, urban design, sustainable development standards, habitat and biological preservation, infrastructure, and mobility. The plan also establishes a trip cap on vehicle capacity at the North Bayshore gateway locations, limiting morning peak period vehicle trips to 18,900 SOV, carpool, and transit trips. To meet North Bayshore's trip and mode share targets, the mobility chapter recommends the development of a new street grid, creation of a transportation demand management (TDM) program, and prioritization of multimodal facilities to promote transit use, bicycling, and walking.

The preferred alternatives described in Chapters 4-6 were created within the context of the Precise Plan and offer a mutually supportive vision for the near- and long-term future of the Shoreline Boulevard corridor.



BICYCLE TRANSPORTATION PLAN

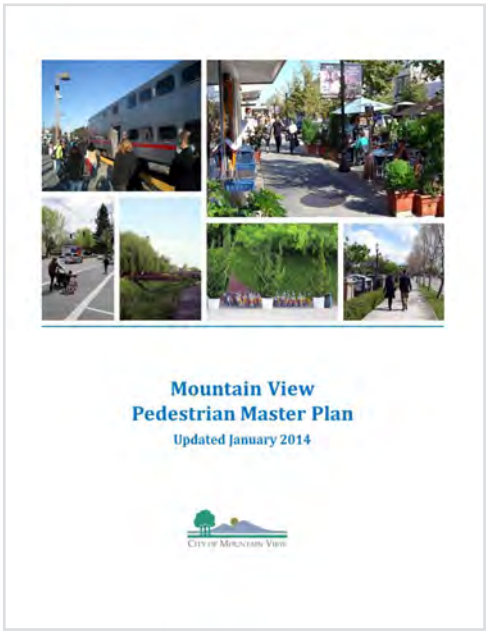
The City of Mountain View is in the process of updating its Bicycle Transportation Plan (2008). The update to the Bicycle Transportation Plan will include a comprehensive assessment of bicycle facilities, ridership and safety trends, and community needs throughout the whole city. It will recommend a revised bicycle network and propose a series of infrastructure and programmatic improvements. The preferred alternatives for Shoreline Boulevard and Stierlin Road will be incorporated into this Bicycle Transportation Plan and identify the optimal ways in which to best connect these proposed facilities to the rest of the city's existing and future bicycle network. The Bicycle Transportation Plan is scheduled to be finalized by the end of 2015.

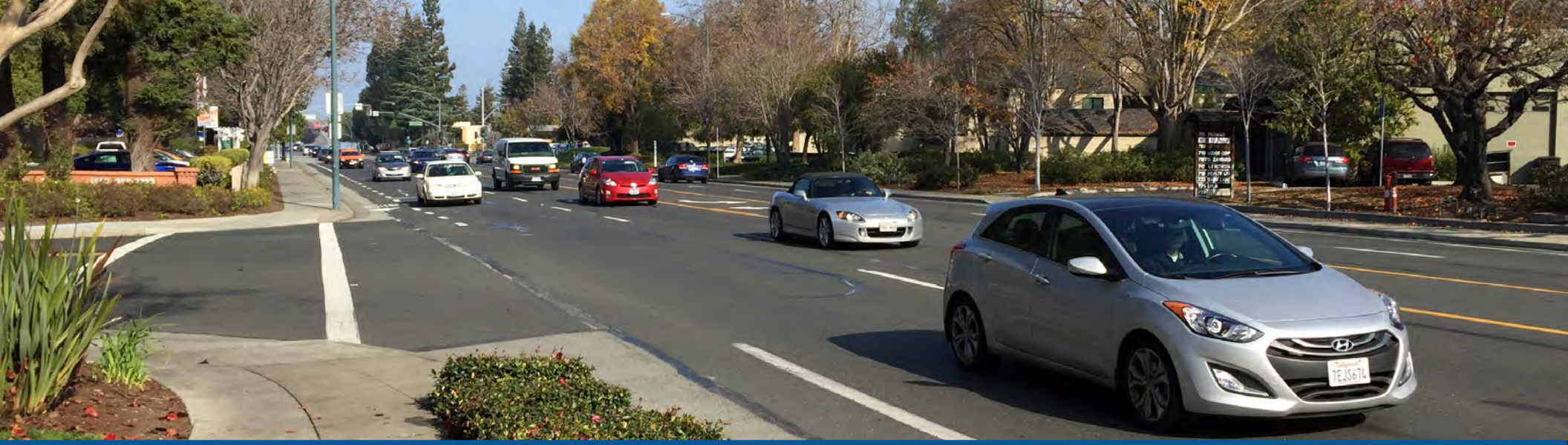


The preferred alternatives for Shoreline Boulevard and Stierlin Road will be incorporated into the Bicycle Transportation Plan Update.

PEDESTRIAN MASTER PLAN

In January 2013 the City of Mountain View adopted the City's first Pedestrian Master Plan. The Plan is a citywide policy document that expands upon the 2030 General Plan mobility goals to provide specific tools and implementation strategies to achieve these goals and address the pedestrian-related needs of the community. In particular, the Plan focuses on programs and infrastructure improvements that will help the City achieve its mobility goals identified in the 2030 General Plan. The Plan includes several supporting recommendations for the Shoreline Boulevard corridor including: 1) streetscape and pedestrian environment enhancements along Shoreline Boulevard; 2) enhanced pedestrian circulation at the Mountain View Transit Center; and 3) targeted intersection improvements along Shoreline Boulevard.





CHAPTER 3

EXISTING CONDITIONS & OUTREACH

In order to understand the key issues, constraints, and opportunities in the Shoreline Boulevard corridor area, existing conditions were analyzed and three rounds of community outreach were conducted. Multiple agencies and stakeholder groups were consulted in order to refine the alternatives and ensure that community concerns were reflected in the study recommendations.

SUMMARY OF EXISTING CONDITIONS

A summary of the existing conditions analysis is provided in this chapter, with a specific focus on the key findings as they relate to vehicle, transit, bicycle, and pedestrian travel in the greater Shoreline Boulevard corridor.

Southbound traffic congestion in the evening on Shoreline Boulevard.

STREET NETWORK

Key Finding: Portions of Shoreline Boulevard already exceed vehicle capacity during the peak periods. Vehicle traffic is primarily northbound in the morning and southbound in the evening.

Traffic counts for numerous intersections, including the key access points to the North Bayshore area (San Antonio Road, Rengstorff Avenue, Shoreline Boulevard, and Bayshore Road), were conducted as part of the 2013 Shoreline Transportation Study. Of these major streets, Shoreline Boulevard serves the highest volume of traffic, which exceeds that roadway's designated "capacity" in the morning peak period (with "capacity" being defined as delays to motor vehicles that result in motor vehicle level of service (LOS) E or lower[1]).

1 Level of service is a measure of vehicle delay at intersections, ranging from "A" (little or no delay) to "F" (extreme delay with intersection capacity exceeded).

The other gateway corridors also experience high volumes of traffic, but remain below capacity and are underutilized during peak commute periods. These corridors, however, are expected to reach capacity in the future as a result of the projected growth in vehicular trips for the area. This growth is expected even with a shift in the existing mode share split.

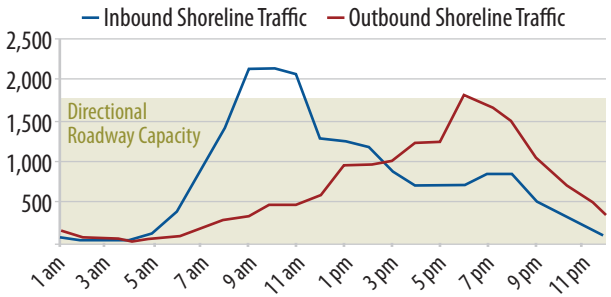
Furthermore, traffic data indicates that peak traffic flows are largely uni-directional. In the morning, traffic flow is predominantly in the northbound direction into North Bayshore. The reverse traffic flow occurs in the evening. Figures 3-1 and 3-2 summarize these findings.

FIGURE 3-1 GATEWAY ROADWAYS – TRAFFIC COUNTS AND CAPACITY UTILIZED

Gateway	Designated Capacity (veh/hr)	A.M. Peak (7-10 a.m.)				P.M. Peak (4-7 p.m.)			
		In	% capacity	Out	% capacity	In	% capacity	Out	% capacity
San Antonio Road	1,000	1,847	67%	357	22%	919	35%	2,078	80%
Rengstorff Avenue	2,700	4,626	43%	608	11%	797	17%	3,955	38%
Shoreline Boulevard	1,800	6,415	106%	1,018	21%	2,658	42%	4,950	89%
Bayshore Road	1,000	469	33%	152	8%	487	43%	600	44%

Source: Adapted from 2013 Shoreline Transportation Study

FIGURE 3-2 HOURLY DISTRIBUTION OF TRAFFIC VOLUMES ON SHORELINE BOULEVARD, NORTH OF US-101



Source: 2013 Shoreline Transportation Study

Key Finding: The most impacted locations along Shoreline Boulevard are at Middlefield Road and intersections north of U.S. Route 101.

As shown in Figure 3-3, vehicle delay is most significant on Shoreline Boulevard at Middlefield Road and intersections north of U.S. Route 101, with intersection LOS ranging from D to F. It is at these intersections where the greatest bottlenecks occur, creating backups along Shoreline Boulevard and at the on- and off-ramps for U.S. Route 101. Currently, all other intersections along Shoreline Boulevard within the study area operate with minimal vehicle delay.

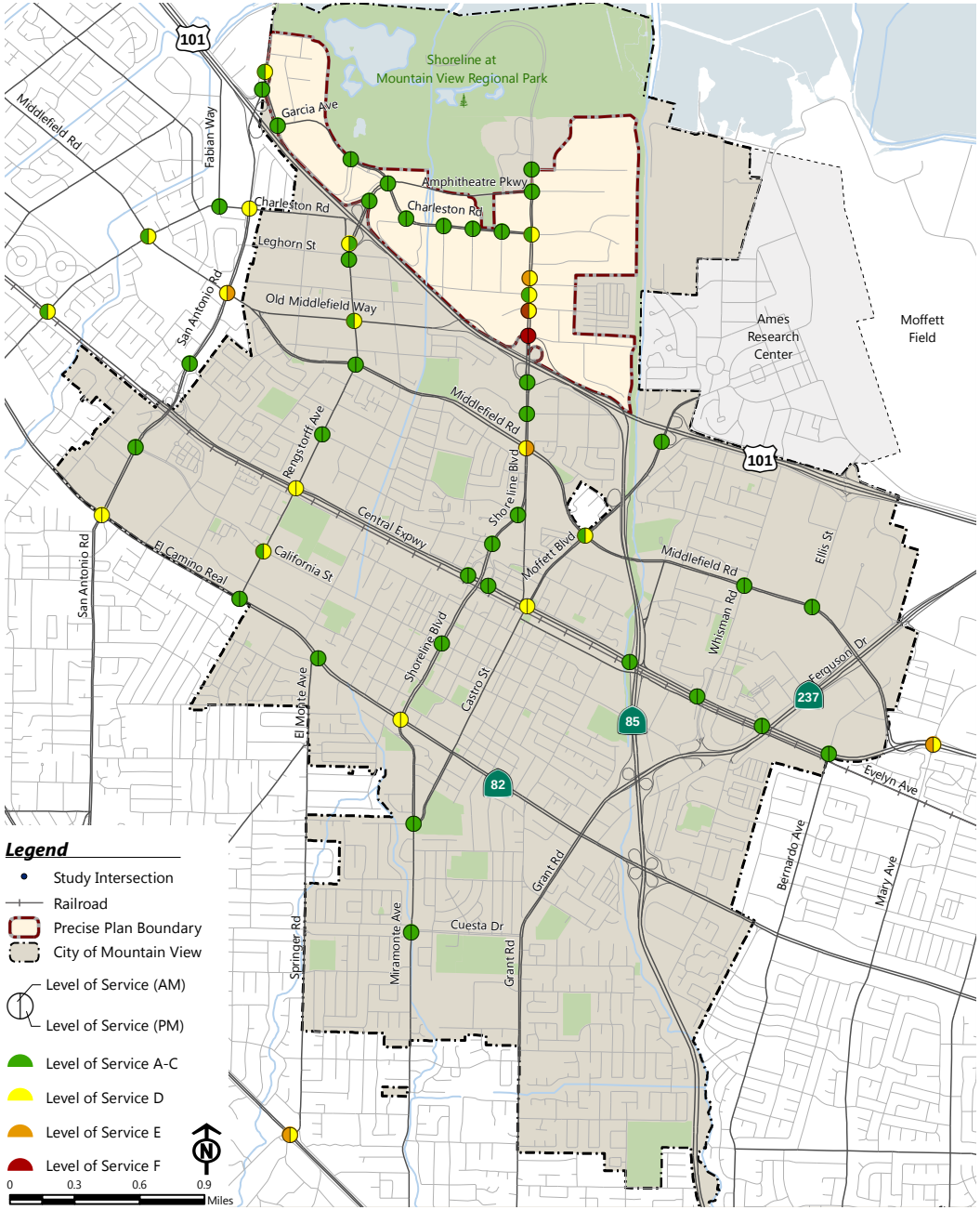
Key Finding: Congestion causes an increase in travel time and trip distance for transit vehicles.

The level of congestion on Shoreline Boulevard also impacts transit access to and from North Bayshore. Shuttles traveling from the Mountain View Transit Center to North Bayshore experience significant delays during peak periods. The Caltrain Shoreline shuttle service, for example, has reported consistent delays as a result of traffic.

Severe traffic delays on Shoreline Boulevard have led many of the public and private shuttle providers to utilize more circuitous routes (via Rengstorff Avenue or

Transit vehicles waiting in traffic on Shoreline Boulevard.

FIGURE 3-3 EXISTING INTERSECTION OF LEVEL OF SERVICE



Source: North Bayshore Precise Plan – Draft Transportation Impact Analysis (July 2014)

San Antonio Road) to get from the Transit Center to the North Bayshore. Private commuter buses traveling from San Francisco or the South Bay also avoid Shoreline Boulevard and exit U.S. Route 101 at Rengstorff Avenue or San Antonio Road. This adds distance and travel time to their trips into the North Bayshore area, and detracts from the appeal of transit as a travel mode.

TRANSIT SERVICES

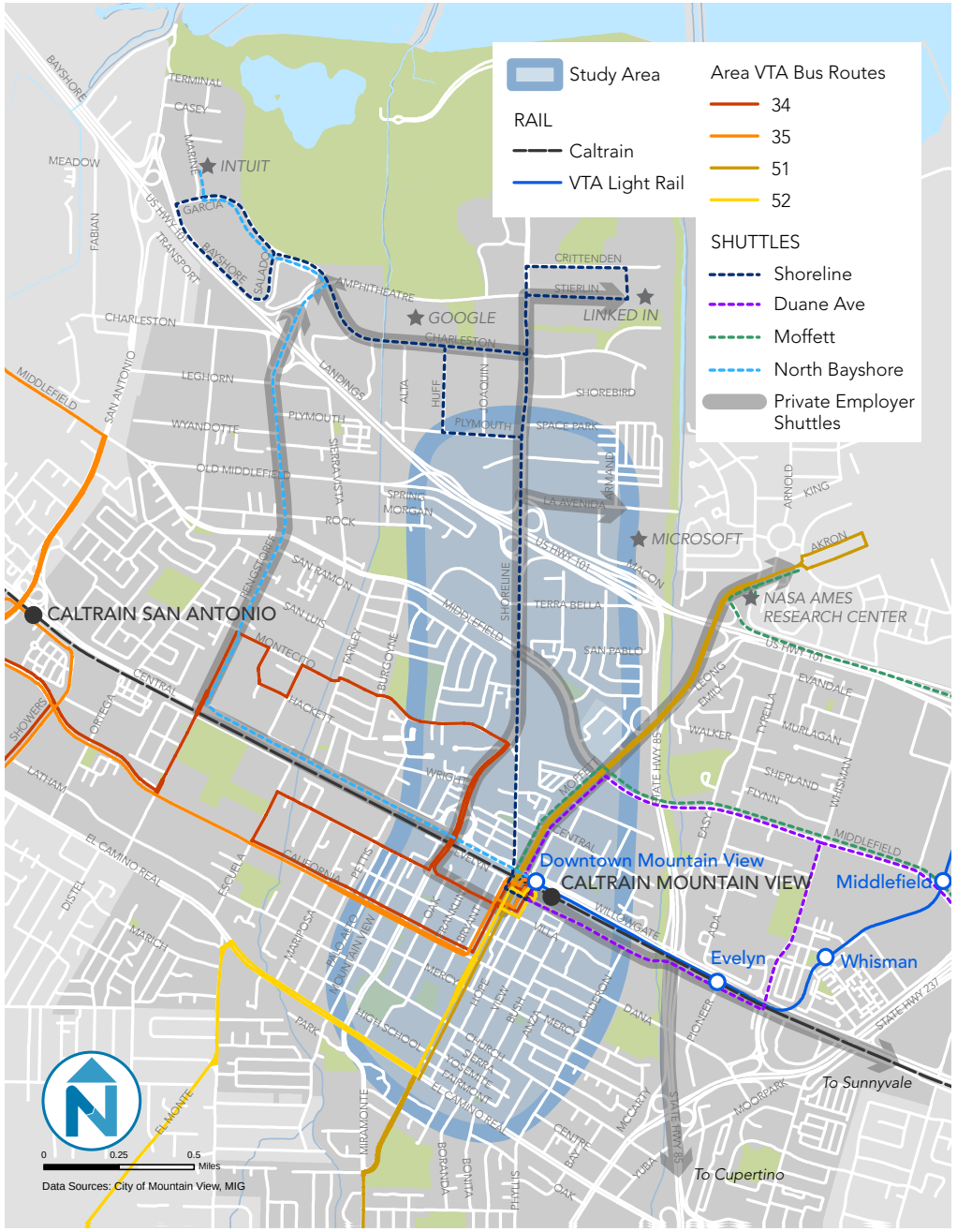
Key Finding: There is a wide range of transit services in the area.

As shown in Figure 3-4, there are a wide variety of transit services within the greater Shoreline Boulevard corridor, downtown, and North Bayshore areas. Transit options include Caltrain, light rail, bus, and shuttle services provided by both the public and private sector. While these services offer a number of transit options within the study area, not all of the services are available to all potential riders. Furthermore, a lack of clear signage and passenger information makes it difficult for those unfamiliar with transit to understand the available services.

Caltrain

Caltrain operates commuter rail service from Gilroy to San Francisco, with a stop in downtown Mountain View. Mountain View is a major station along the Caltrain corridor, with most of the limited-stop and "Baby Bullet" express trains stopping at the station. During the morning peak period, a total of 26 trains stop at the station (13 in the northbound direction and 13 in the southbound direction). During the evening peak period 28 trains stop at the station, 14 in each direction. During midday and off-peak times, Caltrain operates hourly service and does not provide Baby Bullet services, which

FIGURE 3-4 EXISTING TRANSIT SERVICES*



*Does not include the recently launched Mountain View Community Shuttle or the MVgo service.

results in substantially higher travel times to regional destinations during the off-peak hours.

VTA

Valley Transportation Authority (VTA) provides public transportation services within Santa Clara County, including services in the Shoreline Boulevard corridor. These services include bus, light rail, and paratransit services. In the study area, VTA currently operates light rail (Route 902 or the Mountain View-Winchester Line), with a northern terminus at the Mountain View Caltrain Station. It also operates local and regional express buses. Routes 34, 35, 51, and 52 directly serve the Transit Center with destinations at San Antonio Road, Stanford Shopping Center, Cupertino/Moffett Field, and Foothill College respectively. None of these routes provide service along Shoreline Boulevard.

Caltrain Shuttles

In addition to commuter rail services, Caltrain also provides four public shuttle services linking the Transit Center with employment centers in the area. Operating only during peak commute periods, the shuttles are funded in part by the Peninsula Corridor Joint Powers Board (which operates Caltrain), the Bay Area Air Quality Management District's Transportation Fund for Clean Air, and various employers. Caltrain passengers ride for free on the Caltrain shuttles.

Caltrain's shuttles connecting to Mountain View station include:

- **Shoreline Shuttle:** This service operates directly on Shoreline Boulevard and transports passengers to Shoreline area office buildings, including those on the Google campus.
- **North Bayshore Shuttle:** Connects North Bayshore area office campuses (particularly Intuit) with the Transit Center.
- **Duane Shuttle:** Connects the Transit Center and the Lawrence Caltrain station, serving Duane area office buildings (particularly AMD).
- **Mary/Moffett Shuttle:** Connects the Transit Center and Moffett Field along Moffett Boulevard and Mary Avenue.

TMA and Community Shuttles

In early 2015, the City launched a free public shuttle in partnership with Google–the Mountain View Community Shuttle.[2] The new service is free and open to the public and offers two routes serving key destinations throughout Mountain View. In addition, the Mountain View Transportation Management Association (TMA) also launched new shuttle services (MVgo)[3] in early 2015. The MVgo offers three routes targeted at commuters connecting between the Transit Center and the North Bayshore and Whisman areas. Since these services are just beginning, they have not been analyzed in detail in this report.

2 http://mvcommunityshuttle.com/
3 http://mvgo.org/

Caltrain Shoreline shuttle loading in the morning.

Recently launched TMA (left) and community (right) shuttle services.

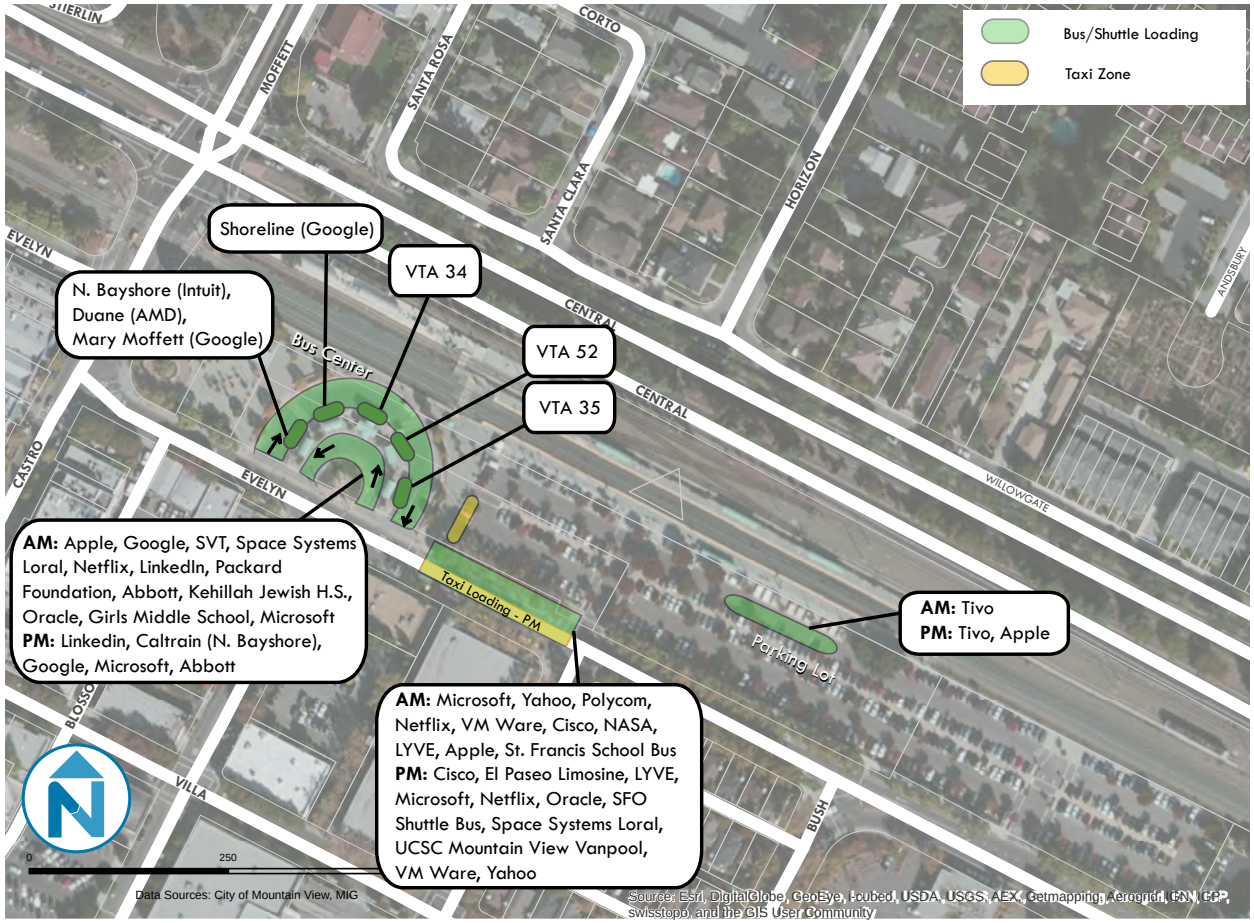
Private Shuttles

In addition to the Caltrain shuttles, which connect several employers and destinations with the Transit Center, numerous local and regional employers also provide direct shuttle services for their employees. These shuttles are popular, as they offer more frequent and direct services that may be beyond the reach of existing public transit services. Employers that provide direct shuttle service to the Transit Center include, but are not limited to: Apple, Microsoft, LinkedIn, Yahoo, Cisco, Oracle, Netflix, and NASA (see Figure 3-5).

In addition to private employers, a small amount of shuttle activity serves private school and university students. These include The Girls' Middle School in Palo Alto and Saint Francis High School in Mountain View.

Additionally, many employers also provide long-distance commuter buses between North Bayshore and San Francisco, the East Bay, and the South Bay. For example, Google operates hundreds of commuter buses each day to various locations in the Bay Area. These commuter shuttle services transport more than 5,000 people to and from North Bayshore each day.

FIGURE 3-5 LOCATIONS FOR TRANSIT VEHICLE LOADING AT TRANSIT CENTER



Private shuttle services loading at the Transit Center.

Key Finding: Mountain View is a regional transit node, and demand for transit services at the Transit Center is expected to continue to grow.

Public and private transit services converge in Mountain View due to the location of the station relative to major employment centers and the fact that Mountain View is a Caltrain "Baby Bullet" station where most trains stop. As shown in Figure 3-6, Mountain View is the third most utilized Caltrain station with more than 4,200 average weekday boardings in 2014, up 10% from the previous year.[4]

A 2013 assessment of average weekday ridership at the station indicates that approximately 12,000 people are getting on and off at the station from public transit services. Ridership data for all private services was not available, but based on observations it is estimated that close to 1,000 riders per day are utilizing private shuttle services at the transit center. As shown in Figure 3-7, these shuttles are coming from all over Silicon Valley and are not just from the North Bayshore or other parts of Mountain View.

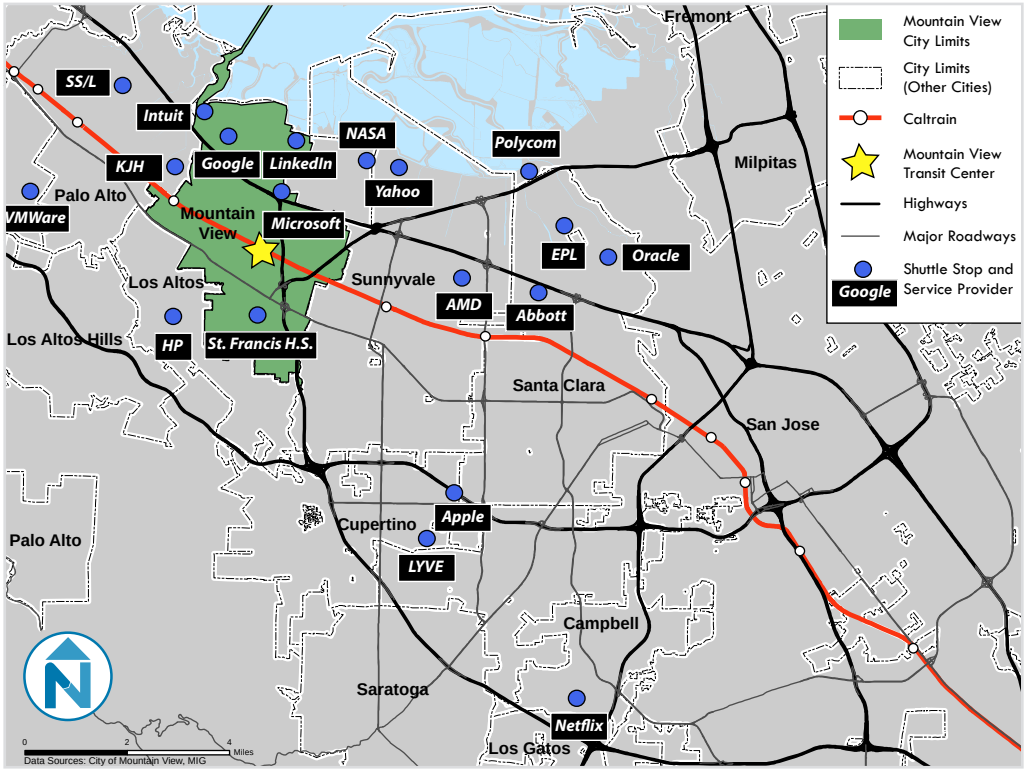
Activity at the Transit Center has reached all-time highs, and it is expected to grow even further. Caltrain has experienced record ridership growth and average weekday riders (as measured in early in 2014) exceed 52,600, a 54% increase from 2010 (Figure 3-8). More recent counts show ridership approaching 60,000. Given the strong economic base on the Peninsula, increasing congestion on US-101 and I-280, and desirable housing options in the Caltrain corridor it is likely that Caltrain ridership will continue to grow.

FIGURE 3-6 CALTRAIN STATIONS WITH HIGHEST RIDERSHIP

Rank	Station	2013		2014		% Change (2013 to 2014)
		Avg. Weekday Ridership	% of System Avg. Weekday Ridership	Avg. Weekday Ridership	% of System Avg. Weekday Ridership	
1	San Francisco	10,786	22.9%	12,160	23.1%	12.7%
2	Palo Alto	5,469	11.6%	6,156	11.7%	12.6%
3	**Mountain View**	**3,876**	**8.2%**	**4,274**	**8.1%**	**10.3%**
4	San Jose Diridon	3,489	7.4%	3,714	7.1%	6.4%
5	Millbrae	3,255	6.9%	3,291	6.3%	1.1%

Source: http://www.caltrain.com/about/statsandreports/Ridership.html

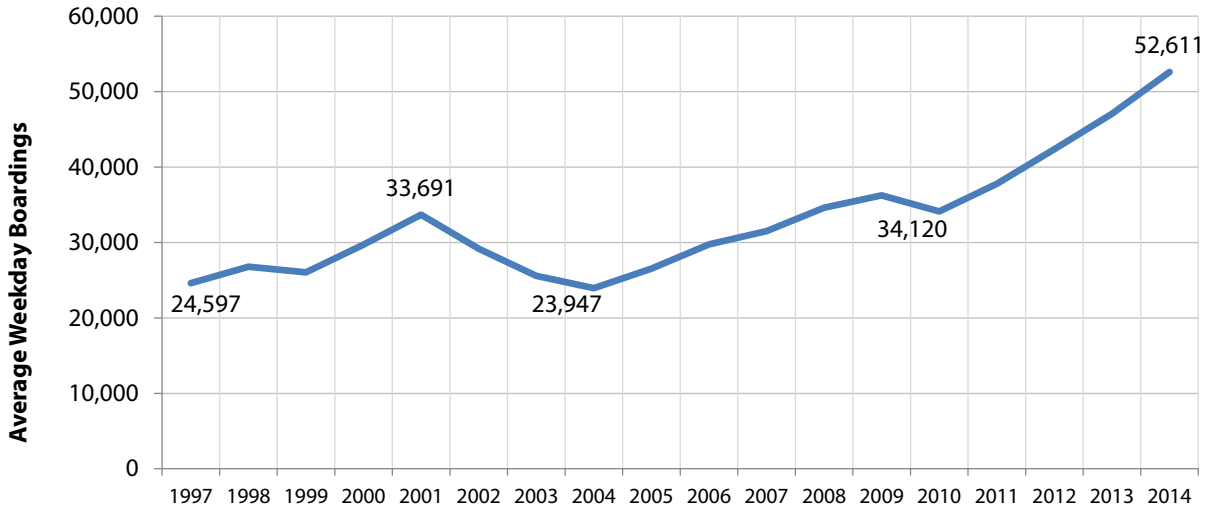
FIGURE 3-7 EMPLOYERS PROVIDING SHUTTLE SERVICE TO MOUNTAIN VIEW



4 http://www.caltrain.com/about/statsandreports/Ridership.html

The number of private shuttles converging at the Transit Center is also expected to grow as a result of continued economic growth in Silicon Valley as well as transportation demand management (TDM) policies mandating a shift away from SOV commute trips. One of the common mitigations is to provide shuttle service to and from Caltrain stations. Given its location and level of service, Mountain View has become one of the most important stops for last-mile shuttle service to these companies.

FIGURE 3-8 CALTRAIN AVERAGE WEEKDAY BOARDINGS (1997-2014)



Source: http://www.caltrain.com/about/statsandreports/Ridership.html

Overall Caltrain ridership increased by 54% from 2010 to 2014.

MOUNTAIN VIEW TRANSIT CENTER

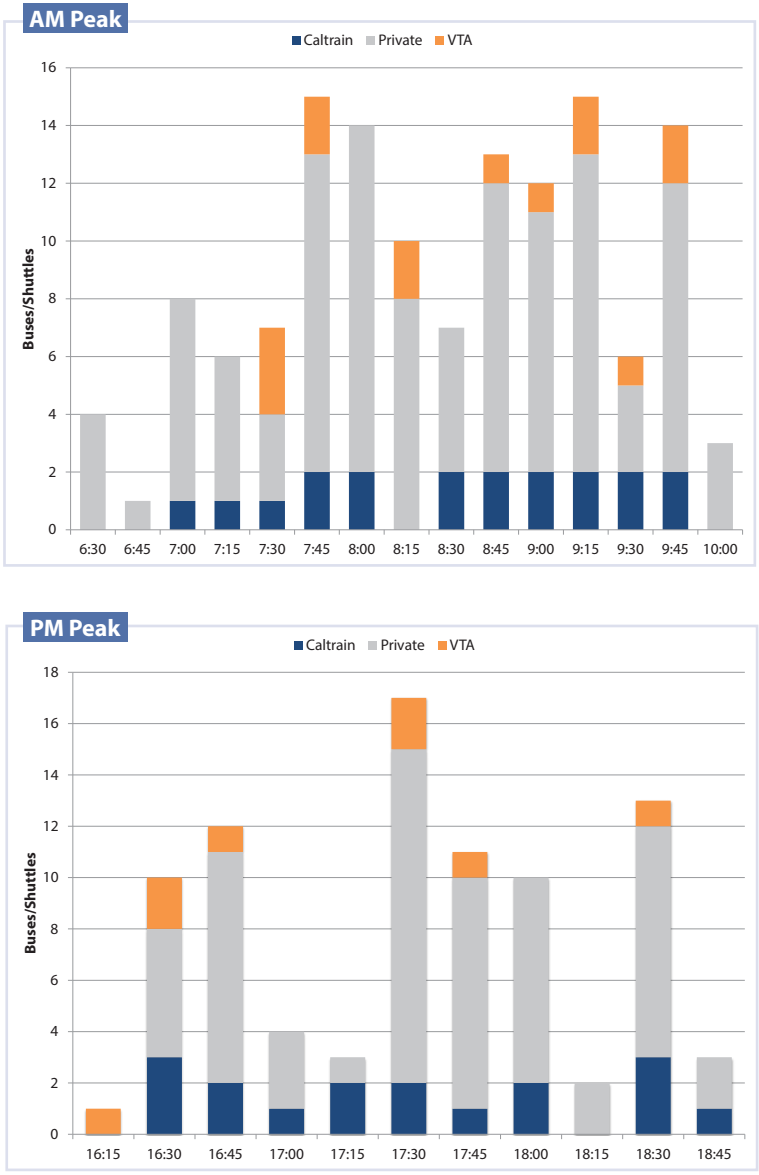
Key Finding: The public and private shuttles are not well coordinated, creating congestion and loading challenges at the Transit Center.

While the increase in transit ridership at the Transit Center supports the City's goal to reduce vehicle trips, the facility was not designed to accommodate such loading activity. The volume of vehicles is impacting operations of the facility and the surrounding streets. Observations indicate that almost 200 public and private buses and shuttles are using the Transit Center during just the morning (6:30–10 a.m.) and evening (4-7 p.m.) peak periods (Figure 3-9).

In general, shuttle activity during the morning peak commute period is much more frequent and less orderly than during the evening peak period. During the heaviest periods of morning activity – between 8:45 a.m. and 9:15 a.m. – shuttles in the inner circle of the Transit Center were observed double-parking and loading passengers in the pull-out lane. Some shuttles even spilled out into Evelyn Avenue, impeding traffic and disrupting pedestrian travel in the area. By contrast, during the P.M. peak period shuttles were much less frequent and generally carried fuller loads.

One factor which exacerbates morning peak congestion is extended periods of shuttle layover, since most shuttles prioritize meeting the Baby Bullet trains. Observations showed that private shuttles could wait as long as 17 minutes, but typically dwelled about 10 minutes while waiting for employees to board. Within the inner circle in particular, this practice caused additional congestion as other shuttles were forced to navigate around these shuttles or double-park to pick up their passengers.

FIGURE 3-9 TOTAL ACTIVITY – A.M. + P.M. VEHICLE ARRIVALS

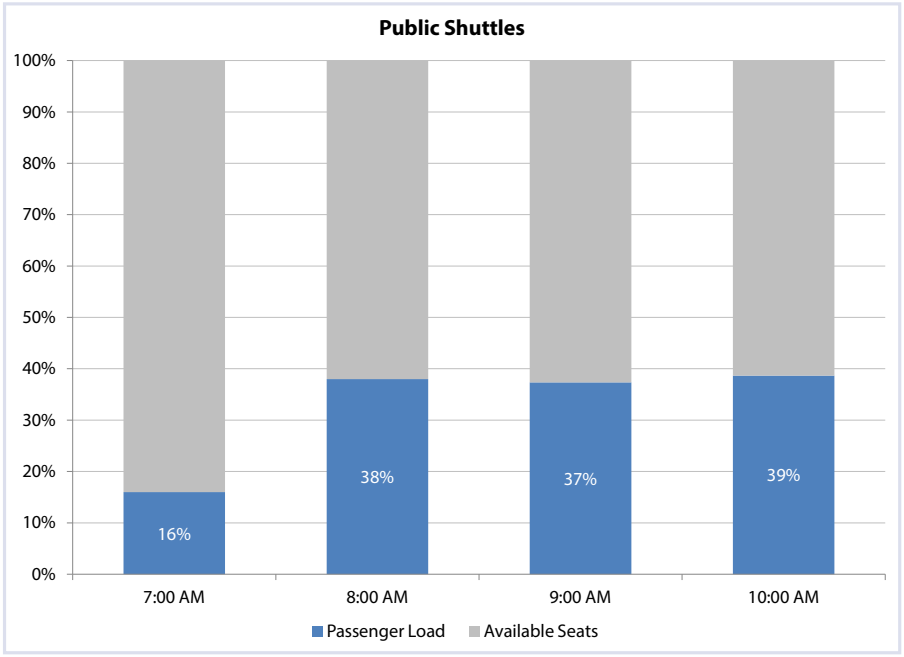


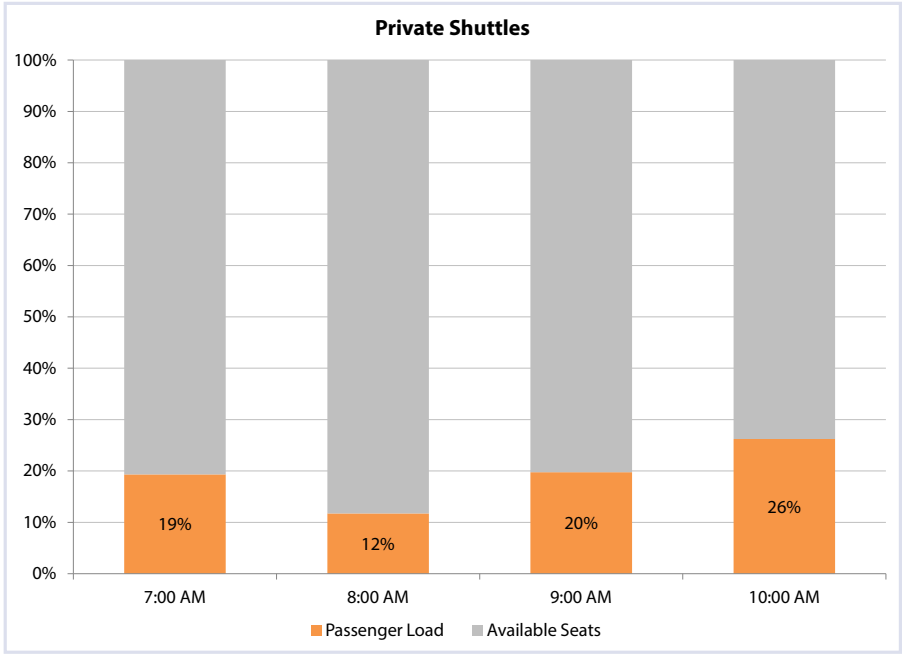
Delays are also caused by confusion, as commuters get lost in the shuffle of numerous shuttles with limited signage identifying the services being provided. Congestion in the inner circle also impacts pedestrian access outside of the Transit Center area as queuing occasionally forces shuttles into the crosswalk at the Evelyn Avenue entrance.

While the large number of shuttles creates significant congestion within the Transit Center, it should be noted that the utilization of the shuttles, especially the privately operated services, was quite low. Figure 3-10 shows that the average passenger load for the public shuttles in the morning peak period was 37%. For private shuttles, the average load was only 19%. These numbers indicate that shuttle services are not being utilized optimally and that improved coordination or consolidation to increase passenger loads has potential to significantly reduce the congestion.

Peak period shuttle activity at Transit Center.

FIGURE 3-10 SHUTTLE CAPACITY AND PASSENGER LOAD, MORNING PEAK PERIOD





Key Finding: There is a growing demand for pedestrian and bicycle access to the station.

Safe and convenient infrastructure for bicyclists and pedestrians is increasingly important in Mountain View and the Shoreline Boulevard corridor. U.S. Census data demonstrates that travel by bicycle and walking has grown substantially over the past decade. Figure 3-11 shows that bicycling and walking as commute modes for Mountain View residents has doubled since 2000. While these are citywide numbers, they indicate a general shift towards biking and walking as key travel modes – a trend that is occurring throughout the Bay Area.

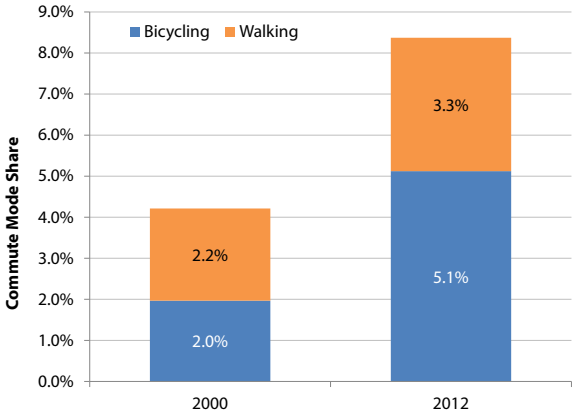
In addition to increasing demand for transit services, key changes in local land use patterns and policies indicate the need for improved pedestrian and bicyclist access in the study area, especially near the Transit Center. These land use changes include Bay Area-wide demand for new mixed use development near transit stations. In Mountain View, the Madera Apartment Complex on Evelyn Avenue was approved in 2010 and completed in early 2013. Demand for these apartments is extremely high. Similarly, the 100 Moffett Boulevard development, a 184-unit, mixed-use apartment complex, is currently under construction with estimated completion in January 2016. As land use changes occur that bring new residents to Downtown Mountain View and the area around the station, more and more trips will be made to the Transit Center by modes other than automobile.

Employers in North Bayshore are now required to meet mode share targets and vehicle trip caps and have implemented strong commute programs to encourage employees to walk, and especially bike, to work. Many companies have on-campus bike share programs and are exploring various bike giveaway and rental programs to encourage employees to bike from home, connect to transit, and to use bikes for midday trips.

The presence of Bay Area Bike Share in Mountain View also has the potential to significantly increase biking in the corridor. While the program is still limited in its scope (with seven stations within Mountain View and none currently in North Bayshore),[5] there is ongoing discussion about how the program can be significantly expanded on the Peninsula. Many North Bayshore employers operate their own bike share programs and recognize the potential value of bike share to connect employees within North Bayshore and to/from the Transit Center.

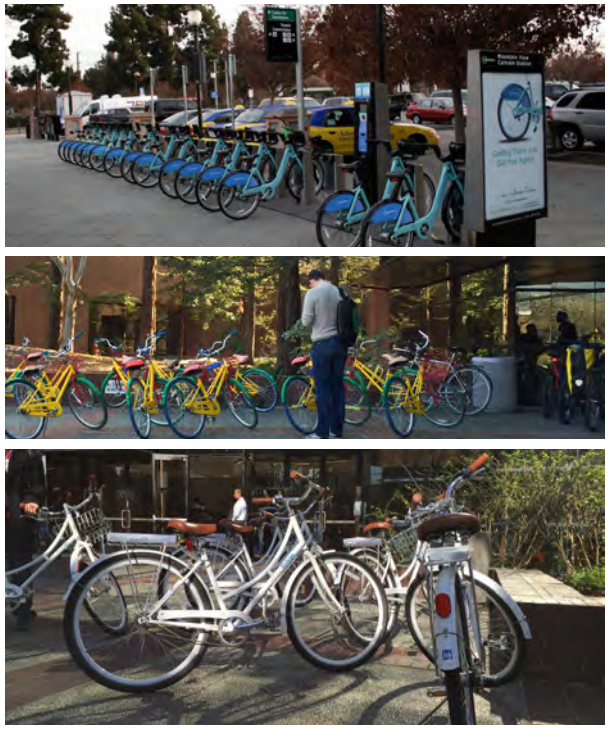
5 Three stations are currently proposed for the North Bayshore in the next year as program expands.

FIGURE 3-11 MOUNTAIN VIEW BICYCLING AND WALKING COMMUTE MODE SHARE, 2000 TO 2012



Source: U.S. Census and American Community Survey

Additional mixed-use development near the Transit Center is being constructed and more is proposed.



Bay Area Bike Share station at the Transit Center and existing private bike share systems in North Bayshore.

Key Finding: The intersection of Central Expressway/Moffett Boulevard/Castro Street is a major barrier.

The intersection of Central Expressway/Moffett Boulevard/Castro Street poses a significant barrier to all users. Access at the intersection is complicated by the presence of the Caltrain tracks and the need to safely clear the tracks when trains are approaching. When trains are stopped at the station, which occurs frequently during peak periods, through traffic on Moffett Boulevard and Castro Street is held, leading to significant delays for travelers trying to cross the tracks. After the gates' down cycle, westbound through traffic continues on Central Expressway along with left turning movements from Central Expressway to Castro Street. Only after the left turn pocket has cleared do the lights change to allow left turns from Moffett Boulevard and Castro Street. The final phase permits through traffic and pedestrian movements across Central Expressway.

During peak conditions, the signal cycle will often not reach the through and pedestrian phase before the gates go down again for the next train. Consequently, pedestrians wishing to cross Central Expressway and motorists exiting downtown face substantial delays. After two or three consecutive cycles in which the through and pedestrian phase does not occur, it is typical to see pedestrians and bicyclists crossing against the light. Delays of up to five or six minutes have been observed and reported. During the evening peak period, traffic leaving the Transit Center parking lot also frequently queues along both Evelyn Avenue and Castro Street.

In addition to the signal phasing challenges, the intersection is very wide, traffic moves at high speeds, and crossing distances are substantial. All factors contribute to an environment that presents significant challenges to pedestrians and bicyclists.

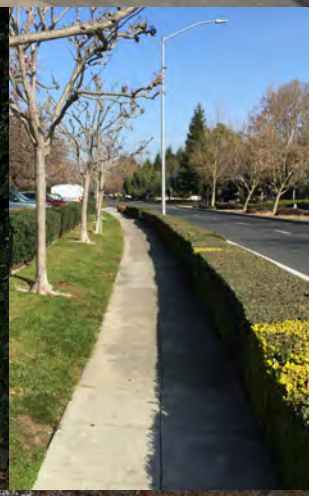
Pedestrians and bicyclists navigate the Central Expressway/Moffett Boulevard/Castro Street intersection.

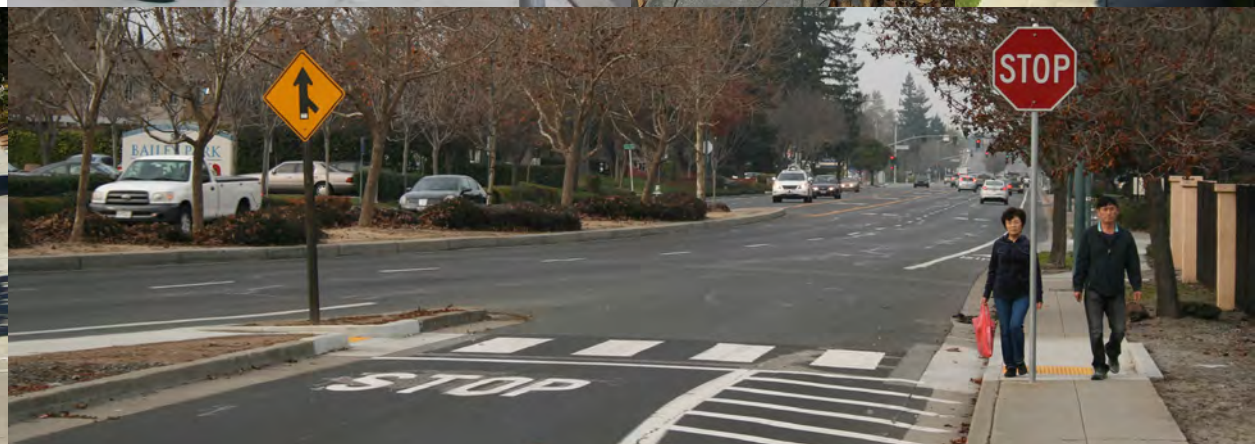
BIKE AND PEDESTRIAN NETWORK

Key Finding: The street network is primarily designed for vehicles and has minimal accommodations for bicyclists or pedestrians.

Stierlin Road was originally the direct route between the North Bayshore area and downtown. The Expressway system and widened arterials were subsequently constructed to accommodate new residential development. Eventually Shoreline Boulevard was widened and emerged as one of the primary north-south arterials in the City.

Shoreline Boulevard and its major cross streets offer the opportunity to walk or bike, but fast-moving traffic dominates the street environment. Bicycle lanes, where they exist, are narrow and directly abut vehicle traffic. Sidewalks are narrow and adjacent to uninviting streetscapes. Ultimately, the street network is defined by its vehicle-oriented design, which has limited the attractiveness of biking, walking, and transit as viable modes of travel.





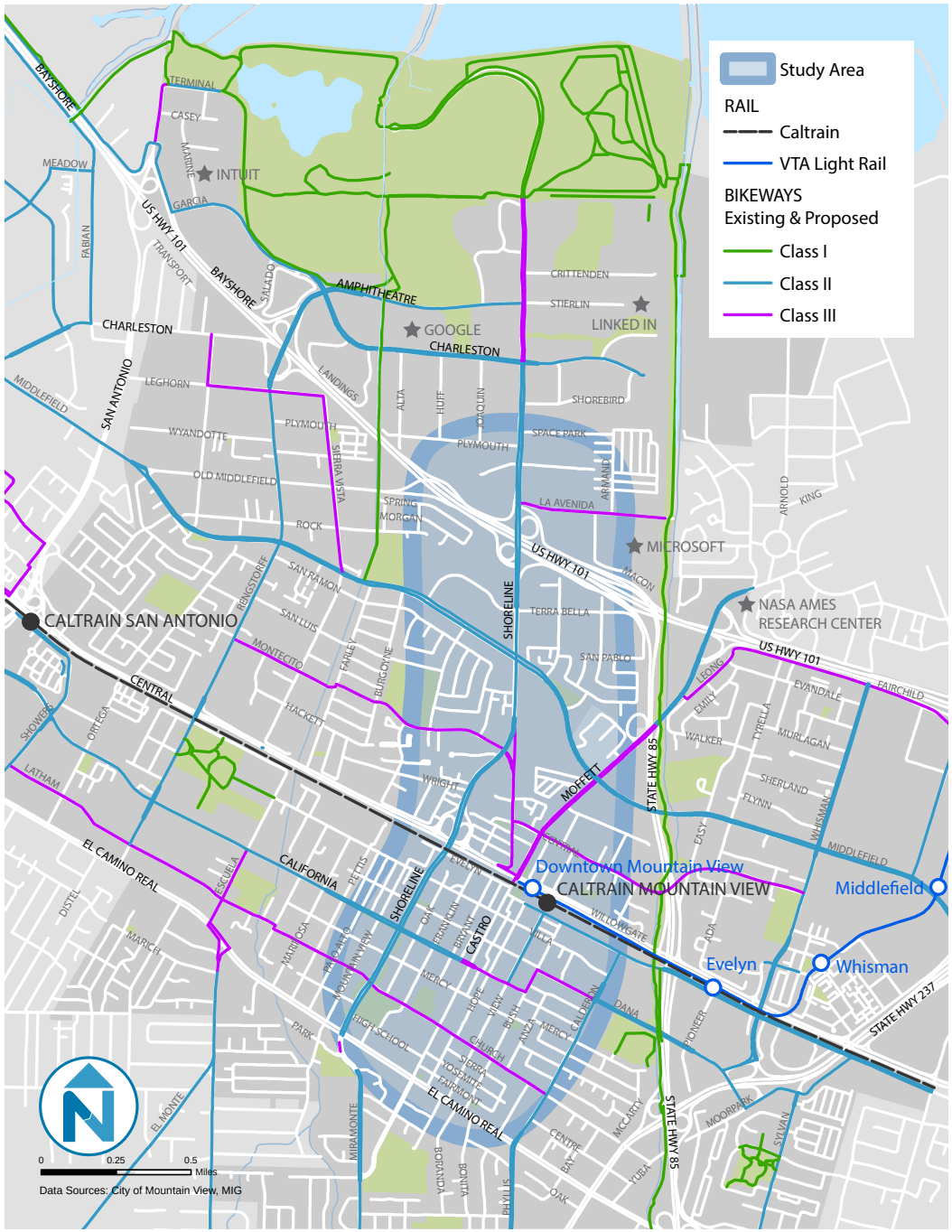
Bicycle and pedestrian conditions in the study area.

Key Finding: The bicycle network needs improvement to attract greater bicycle use.

The City of Mountain View has made significant investments in its bicycle network. In particular, the City has developed high-quality trail facilities with the Permanente and Stevens Creek trails. These facilities provide a comfortable and inviting biking experience, but do not provide a direct connection between Downtown and North Bayshore. In addition, less experienced riders may still find these facilities unappealing due to the higher travel speeds of bicyclists and lack of adequate lighting, especially during the winter months. The overall bicycle network is fragmented and connections to/from these facilities are limited.

On-street facilities that do exist are inadequate for most bicyclists. Bicycle lanes on Middlefield Road, Evelyn Avenue, and Shoreline Boulevard are only four to five feet in width and adjacent to vehicle lanes. These facilities are beneficial, but they do not provide the physical separation that is needed to encourage less experienced bicyclists to ride. The lack of high-quality, separated bicycle facilities throughout the bicycle network significantly limits the ability of bicyclists to access Mountain View's world-class trails or use the network to commute or make other trips.

FIGURE 3-12 EXISTING BICYCLE NETWORK



Key Finding: Major barriers limit pedestrian and bicycle travel.

One of the biggest challenges in the study area to growing bicycle and pedestrian travel is the presence of a number of prominent barriers. Such barriers present both a physical and psychological obstacle for many who might wish to walk or bike, but are afraid or deterred from doing so. These barriers contribute to travel decisions that default to vehicle trips because the idea of walking or biking is challenging. Providing the proper infrastructure to mitigate these barriers will be crucial to increase walking, biking, and transit trips in the corridor. These barriers include:

- **Central Expressway/Moffett Boulevard/ Castro Street:** As discussed, this intersection is particularly challenging for bicyclists and pedestrians wishing to access downtown or the Transit Center. Its limited accommodation for these modes negatively impacts any desire to use the Transit Center and limits connectivity to downtown and the city's commercial core.
- **U.S. Route 101:** The freeway has long been identified as a significant barrier to travel in the corridor. Vehicle access to the on- and off-ramps creates a major bottleneck and congestion. Bike lanes and sidewalks provide access on the overcrossing, but these facilities are narrow and uninviting. Only the most experienced bicyclists will utilize the bike lanes on Shoreline Boulevard at this location.
- **Arterials and Intersections:** The study area's street network is defined by wide arterials, prominently Shoreline Boulevard and Middlefield Road, that create significant crossing distances at every intersection. Intersections throughout the corridor are difficult to navigate and deter travel on foot or by bike. Crosswalks provide minimal accommodation, but pedestrians and bicyclists are forced to maneuver around large numbers of right-turning vehicles. Long blocks and limited dedicated crossings also impact the utility of walking the corridor and contribute to jaywalking throughout the study area.

Major barriers present significant challenges to multimodal travel.

COMMUNITY OUTREACH PROGRAM

In order to achieve a better understanding of the Shoreline Boulevard corridor area, this study included a comprehensive outreach program to capture input from the larger Shoreline Boulevard and North Bayshore community, as well as key regional stakeholders. The outreach effort was designed to be robust, inclusive, and innovative. The input was used to confirm and refine a cohesive corridor vision, as well as provide input at key stages in the project to guide the development of alternatives and final recommendations. The major components of the outreach plan are included:

- Project website and project-specific collateral
- E-blasts and press releases
- Community survey
- Mobile workshops
- Three public workshops
- Three stakeholder workshops
- More than a dozen individual meetings with regional agencies and community groups
- Three presentations to City Council

PROJECT WEBSITE AND COLLATERAL

A project website (www.shorelinecorridor.com) was developed and launched in February 2014. The website was updated throughout the project to provide the latest project information and materials. The website had approximately 2,900 unique visits over the life of the project. The site includes:

- Project overview
- Links to community survey
- Library section, with relevant documents and materials
- Information about meetings and workshops
- Form to submit feedback and comments directly to project staff
- Contact links

The following collateral materials were developed and distributed during the various phases of the outreach effort:

- Project logo
- FAQs
- Press releases
- Flyers promoting the public workshops
- 3,000 business cards with Qwerty and web links for the community survey

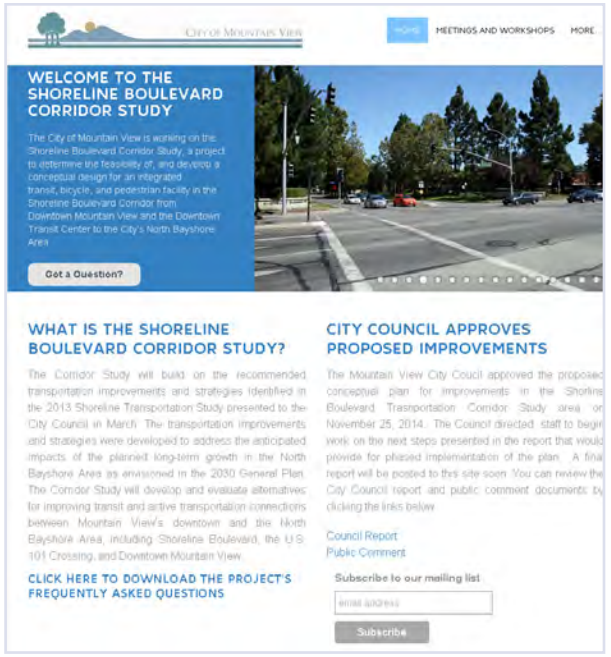


Image from www.shorelinecorridor.com

E-BLASTS AND PRESS RELEASES

Working with City staff, the consultant team created a comprehensive stakeholder list which included more than 100 individuals and groups. E-Blasts were created to promote the website launch, survey, and workshops. The notifications were sent to the entire list prior to each public workshop. The Mountain View Chamber of Commerce, the Downtown Business Association, and all of the individual neighborhood associations identified by the City were also contacted on an individual basis.

News releases promoting the workshops, survey, and website were also developed and released by the City's community relations staff. Postings were sent to the *Mountain View Patch*, the *Mountain View Voice*, and several local transportation blogs to promote the workshops. The City also utilized its social media channels to promote the project and workshops.

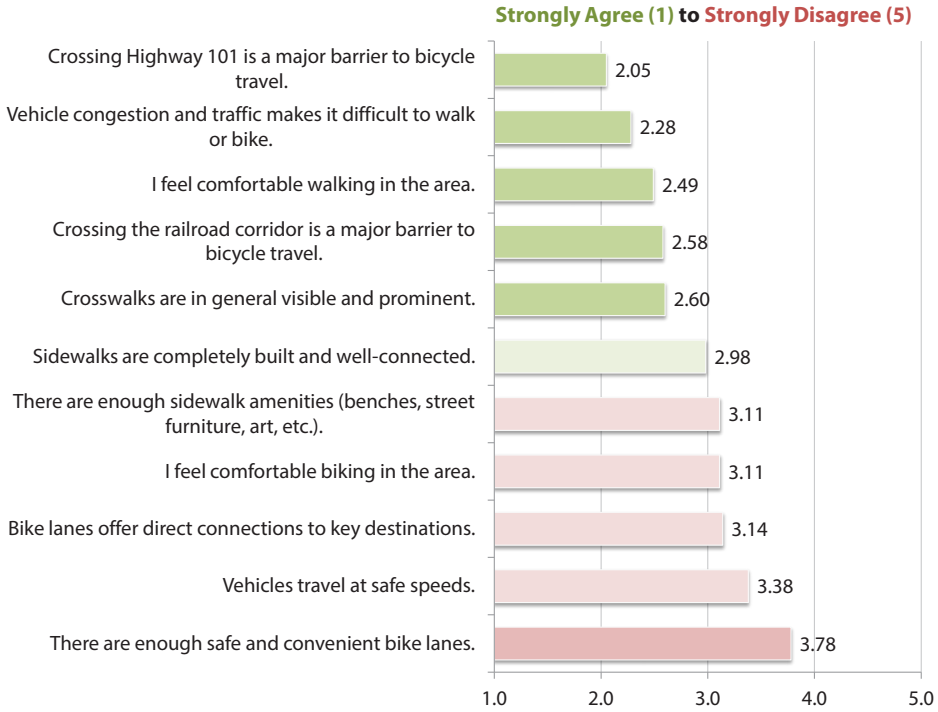
COMMUNITY SURVEY

An online survey was developed through coordination with City staff. The survey was designed to identify travel behaviors for residents, employees, and visitors in the corridor and solicit input on key mobility challenges and issues. Questions were also designed to gauge community preferences for potential infrastructure and programmatic improvements to the transportation network. The primary focus of the survey was on transit, bicycle, and pedestrian infrastructure, as well as the physical and operational design of the Mountain View Transit Center.

The survey was made available to the public in early February 2014 and was open for a month. It was posted on the project website and made available to participants at the community meetings as well as the mobile workshops via smartphone, tablet, and hard copy. The survey was also advertised on the City website and via press releases. More than 500 responses were generated and were used to inform the development of project alternatives.

Figure 3-13 provides an example of the feedback received in regards to bicycle and pedestrian travel in the corridor. The survey results confirm that the crossing of U.S. Route 101 is a major challenge for pedestrians and bicyclists, and that vehicle congestion and travel speeds contribute to an uninviting and hazardous environment for these modes. Respondents also indicated a desire for additional bike lanes, especially ones that directly connect to major destinations.

FIGURE 3-13 LEVEL OF AGREEMENT/DISAGREEMENT ON BICYCLE AND PEDESTRIAN ISSUES



Source:
Shoreline Boulevard Corridor Community Survey

MOBILE WORKSHOPS

As part of the first phase of outreach, mobile workshops and site visits were conducted at these locations:

- Intuit Campus
- Google Campus
- Mountain View Transit Center
- Local businesses in the corridor
  - Starbucks (Pear Avenue and Shoreline Blvd.)
  - Center of Balance
  - Castro Street
- Rotary Club of Mountain View

Both Intuit and Google sent out e-blasts to their entire campuses of more than 10,000 employees to promote the event. Locations were selected in high volume traffic areas to maximize participation. It is estimated that over 500 people participated at each location. Participants were able to view interactive display boards, respond to the survey via laptop/tablet, pick up project collateral, and ask staff about the project. The Transit Center was staffed during morning, evening, and weekend hours. Members of the consultant team handed out additional cards while actively riding Caltrain, VTA buses, and commuter vans from the Transit Center to the Google and Intuit campuses.

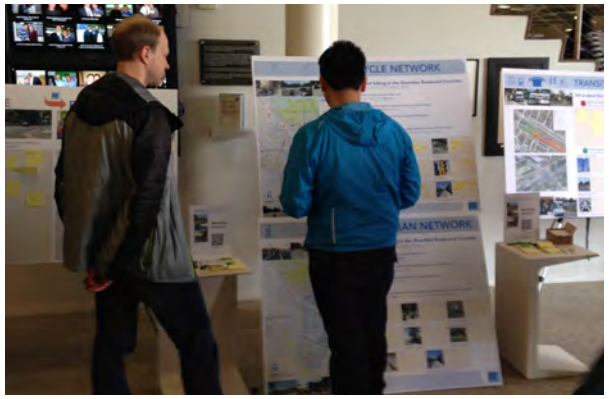
The project team also spent time engaging members of the public and business owners located in the shopping/dining area at the corner of Pear Street and Shoreline Boulevard, businesses and patrons along Castro Street, and Center of Balance on Pear Street. Individuals and businesses were provided with posters promoting the project and business cards with web and survey links.

PUBLIC AND STAKEHOLDER WORKSHOPS

To inform the community of the project and solicit more detailed feedback, three rounds of workshops were held at various stages of the project. During each round, one meeting was open to the general public and a second meeting was held specifically for key stakeholders, such as employers and their transportation staff, local businesses, local and regional agencies, and property owners. All meetings were held at either the Adobe Building or the Computer History Museum. The public meetings were advertised to the greater Shoreline Boulevard and Mountain View community via e-mail blasts to both the City's and the project's contact lists, postings on the project website, and a press release to local media outlets.

The first round of workshops was held in February 2014. The primary goal of the meetings was to introduce the project to the community and stakeholders and solicit input on key challenges and opportunities in the corridor. Each meeting was attended by approximately 30-40 people. City and consultant staff provided a brief summary presentation. Participants were then split into small groups and rotated to a series of interactive stations where their input was solicited on various components of the transportation network, including: current use and future vision, bicycle and pedestrian network, transit services, and the Transit Center.

The second round of workshops was held in May 2014. Both meetings began with a brief presentation by City and consultant staff reviewing the goals of the project, work completed to date, and key findings. An introduction to the small group exercise and the conceptual alternatives was also provided. Attendees then went to one of five small group stations where an overview of the key findings and initial recommendations was presented in more detail by a facilitator. Meeting participants were able to ask questions, provide feedback, and leave written comments on each proposed alternative. The alternatives were then made available via a "virtual" workshop on the project website to allow people to review the concepts and provide further feedback.



Outreach activities included surveying transit riders and North Bayshore employees.

The third round of workshops was held in October 2014. Approximately 25 people attended the stakeholder workshop and another 30 attended the public workshop. Both meetings included a presentation by staff of the project history, community input to date, preferred alternatives and design concepts, and next steps. The primary focus of the presentation was to highlight the proposed streetscape changes along Shoreline Boulevard and Stierlin Road and discuss key features such as the transit lane and separated bicycle lanes. Attendees were then able to ask staff questions about the project. The remainder of the meetings included an open house session where attendees could view the proposed designs in greater detail at a series of boards and engage in more detailed conversations with staff. The presentation and design concepts were then made available via a "virtual" workshop on the project website to allow people to review the concepts and provide further feedback.

Members of the public were able to provide feedback at three public workshops.

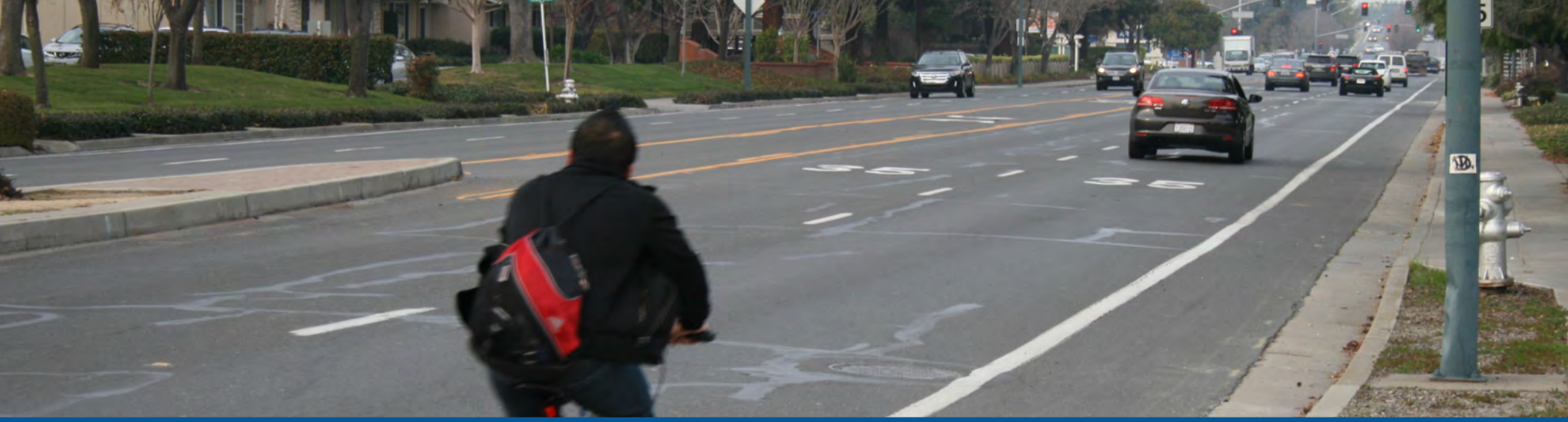
STAKEHOLDER MEETINGS

In addition to the larger workshops, City and consultant staff interacted with key stakeholders in one-on-one meetings throughout the project. These meetings included formal presentations, as well as more general discussions about the project goals, key issues and opportunities, and the proposed improvements. In all, more than two dozen meetings were held with the following stakeholders.

- Transportation staff at major area employers, including Google, Intuit, LinkedIn, and Microsoft
- VTA
- Caltrain
- County of Santa Clara
- Mountain View Transportation Management Association
- Local businesses
- Property owners along Shoreline Boulevard
- Developers
- Buddhist Temple
- Neighborhood and Business Associations

CITY COUNCIL PRESENTATIONS

Presentations to City Council were made on three occasions throughout 2014 to keep members up to date on project work, answer questions, and solicit direction on key issues and proposed recommendations. The dates of the presentations were April 8th, June 24th, and November 25th. An archive of those presentations is available at the City's website (www.mountainview.gov).



CHAPTER 4

CORRIDOR IMPROVEMENTS

Preliminary concepts to create safer, more convenient, and inviting conditions for multimodal mobility within the Shoreline Boulevard corridor were presented to the City Council in April 2014. These concepts were further refined into more detailed alternatives and presented to the City Council in June 2014. The alternatives illustrated the tradeoffs between various design concepts and provided a framework by which to evaluate components of the desired transit, bicycle, and pedestrian improvements. A preferred package of corridor improvements was presented in November 2014 and approved by the City Council.

The various elements of the package were drawn from previous city studies and plans, the project's community outreach program, discussions with stakeholders, emerging best practices and national design guidelines, as well as input from city and consultant staff. The initial alternatives and preferred package of improvements are described by corridor segment. For the preferred package of improvements, key design issues or features are highlighted and discussed in greater detail.

Elements of the package were drawn from previous city studies and plans, the project's community outreach program, discussions with stakeholders, emerging best practices and national design guidelines, as well as input from city and consultant staff.

SUMMARY OF INITIAL ALTERNATIVES

U.S. ROUTE 101 CROSSING

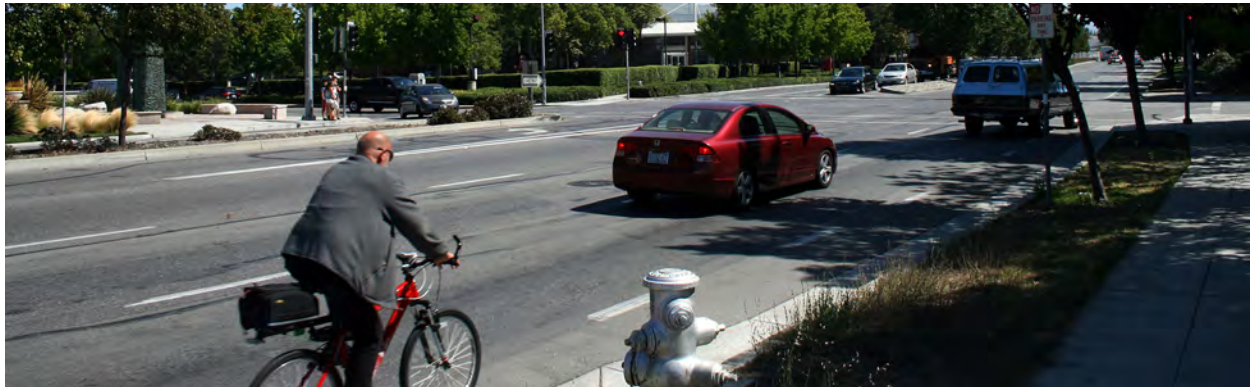
The following three alternatives were considered for the Shoreline Boulevard crossing of U.S. Route 101:

- **Alternative 1:** Center-running, reversible transit lane on the Shoreline Boulevard overcrossing and construction of a new bike and pedestrian bridge over U.S. Route 101 to the west of the existing Shoreline Boulevard interchange.
- **Alternative 2:** Side-running transit lanes on the Shoreline Boulevard over a crossing and construction of a new bike and pedestrian bridge over U.S. Route 101 to the west of the existing Shoreline Boulevard interchange.
- **Alternative 3:** Construction of a transit/bike/pedestrian bridge over U.S. Route 101 to the west of the existing Shoreline Boulevard interchange.

All three alternatives included an option to retain and enhance the existing bike lanes on the Shoreline Boulevard overcrossing.

The center-running, reversible transit lane with the new bike/pedestrian bridge (Alternative 1) was supported by City Council for the entire corridor as the preferred alternative for further evaluation and design. Based on a preliminary analysis and screening, it was determined that the center-running, reversible lane offered more benefits than the side-running lanes. The reversible transit lane would: have higher travel time savings and fewer conflict points with right-turning vehicles due to its physical separation; maximize roadway capacity and better manage peak travel patterns due to its reversibility; offer more potential for landscaping and enhanced urban design, improving the tree canopy in other portions of the corridor; and have substantially smaller right-of-way impacts. The preferred alternative also provided for the preservation, and enhancement of the existing bicycles lanes on the U.S. Route 101 overcrossing.

A bicycle and pedestrian-only bridge was advanced for further evaluation because maintaining transit access in a direct route along Shoreline Boulevard provided the highest travel time savings for transit vehicles, while minimizing the right-of-way impacts to parcels to the north and south of U.S. Route 101. In addition, initial cost estimates indicated that a new bridge with a transit lane would be substantially more expensive.



SHORELINE BOULEVARD

Along other segments of Shoreline Boulevard, the following alternatives were considered:

- **Alternative 1:** Center-running, reversible transit lane with a two-way protected bicycle lane[1] along either the east or west side of Shoreline Boulevard.
- **Alternative 2:** Center-running, reversible transit lane with a one-way protected bicycle lane on each side of Shoreline Boulevard.
- **Alternative 3:** Side-running transit lanes with a two-way protected bicycle lane along either the east or west side of Shoreline Boulevard.
- **Alternative 4:** Side-running transit lanes with a one-way protected bicycle lane on each side of Shoreline Boulevard.

All four alternatives included improvements to the Middlefield Road and Terra Bella Avenue intersections and pedestrian realm along Shoreline Boulevard.

The one-way protected bicycle lanes (Alternative 2) were supported as the preferred alternative for further evaluation and design. Based on a preliminary analysis and screening, it was determined that the one-way protected bicycle lane offered the greatest benefit to the corridor. The one-way lanes would: provide better access to local land uses on both sides of the street; improve connectivity to the wider bicycle network; better facilitate right-turns by vehicles; minimize conflicts with bicyclists; facilitate more familiar travel movements to bicyclists and motorists, particularly at intersections; and provide an opportunity to enhance the pedestrian realm and urban design elements on both sides of Shoreline Boulevard. Both bicycle lane options (one-way and two-way protected bicycle lanes) were similar in terms of costs and right-of-way impacts.

A center-running bicycle facility for this segment of Shoreline Boulevard was also evaluated, but not advanced, because it would preclude use of the center lane and median on Shoreline Boulevard for transit, further restrict left turns on Shoreline Boulevard, and present more challenging transitions and connections to either side of Shoreline Boulevard and the rest of the bicycle network.

1 Also known as cycle tracks or Class IV bikeways in California (per AB 1193).

STIERLIN ROAD

For the Stierlin Road connection between Shoreline Boulevard and the Mountain View Transit Center, the following alternatives were considered:

- **Alternative 1:** Bicycle boulevard
- **Alternative 2:** Bicycle lanes, with removal of parking on one side of Stierlin Road
- **Alternative 3:** Buffered bicycle lanes, with removal of parking on both sides of Stierlin Road

All three alternatives included improvements to the Stierlin Road/Montecito Avenue/Shoreline Boulevard intersection, modifications to the Stierlin Road slip lane, enhanced pedestrian crossings, and traffic calming elements along Stierlin Road.

The bicycle lanes (Alternative 2) were supported as the preferred alternative for further evaluation and design. The preliminary screening found that this alternative offered the greatest benefit to bicyclists by providing a dedicated lane of travel to directly connect to the Transit Center, while minimizing impacts to on-street parking along Stierlin Road.

MOUNTAIN VIEW TRANSIT CENTER

For the Transit Center and immediate station area, the following options were considered:

- Short-term improvements for the intersection of Central Expressway/Moffett Boulevard/Castro Street, including:
  - Modifications to signal timing to improve pedestrian crossing time
  - Closure of right turn slip lanes
  - Two-stage bicycle crossing treatments
  - Bicycle boxes
  - High-visibility crosswalks and pavement markings
  - Tighter intersection turning radii to reduce crossing distances and slow vehicle turning speeds
- New proposed shuttle loading zones on Evelyn Avenue, Hope Street, View Street, and Central Expressway
- Further coordination with employers, VTA, and the TMA to discuss shuttle-loading revisions
- Proposed short-term changes to the Caltrain parking lot
- Longer term options for providing an elevated concourse and grade separated access across Central Expressway

The first four of these concepts for the station area and Transit Center were advanced for further evaluation and design. The elevated concourse and grade separated access across Central Expressway were deferred for further assessment due to the emerging need for a master plan of the Transit Center area including additional study of the potential grade separation of the rail line.

For the other options the City Council indicated a need for additional coordination with the County, Caltrain, and VTA, as well as further development of longer-term solutions to address challenges related to station capacity and the potential need for grade separation. The County has suggested that short-term options include the elimination of left turn access from Castro Street to Central Expressway in order to accommodate an additional pedestrian crossing phase on the western leg (north-south crossing of the expressway).

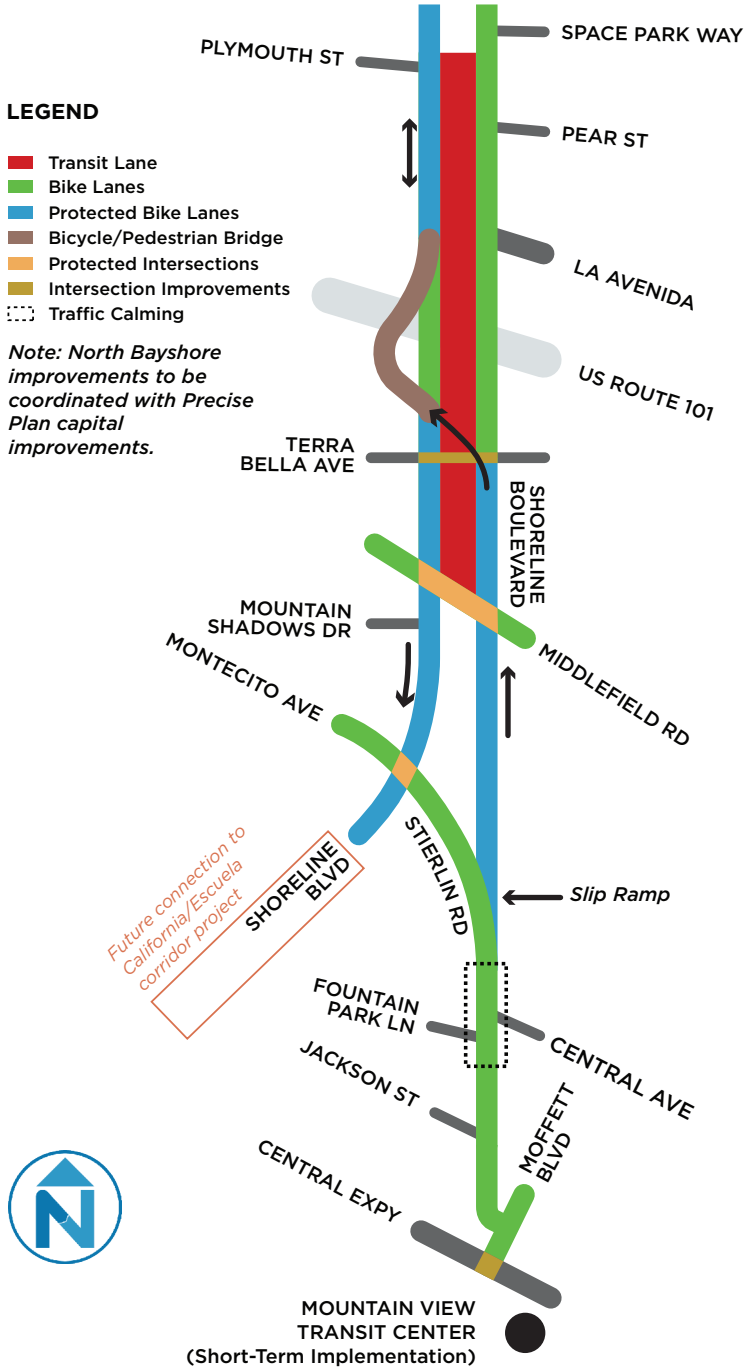
PREFERRED PACKAGE OF CORRIDOR IMPROVEMENTS

The preferred package of corridor improvements is expected to provide optimal benefits in terms of multimodal mobility, safety, convenience, and urban design within the Shoreline Boulevard Corridor. Figure 4-1 provides an overview of the preferred package of corridor improvements. It highlights the core components of the recommendations and their location, including:

- Construction of a new bicycle/pedestrian bridge and connecting two-way protected bicycle lanes over U.S. Route 101
- Enhancements to existing bicycle facilities on the U.S. Route 101 overpass
- Improvements to the intersection at Shoreline Boulevard/Terra Bella Avenue, including a new scramble phase for bicyclists and pedestrians
- New protected intersection features at the Shoreline Boulevard and Middlefield Road intersection

- Construction of a center-running, reversible transit lane on Shoreline Boulevard from Middlefield Road to Plymouth Avenue
- Installation of one-way protected bicycle lanes on Shoreline Boulevard from Stierlin Road to Terra Bella Avenue, including a protected bicycle lane with vehicle access to the Buddhist Temple via the Stierlin Road slip lane
- New protected intersection features at the Montecito Avenue and Shoreline Boulevard intersection
- New bicycle lanes on Stierlin Road, with additional pedestrian and traffic calming features
- Intersection improvements to enhance safety and accessibility at the Central Expressway/ Moffett Boulevard/Castro Street intersection
- Pedestrian and bicyclist access improvements, plus loading and operational changes for shuttles, at the Mountain View Transit Center

FIGURE 4-1 SUMMARY OF PROPOSED IMPROVEMENTS



SHORELINE BOULEVARD AND U.S. ROUTE 101 CROSSING

Proposed Improvements

Space Park Way/Plymouth Street to La Avenida

The segment of Shoreline Boulevard from Space Park Way to La Avenida falls within the North Bayshore Precise Plan. The Precise Plan includes a comprehensive mobility element, which provides design standards for the street network, including Shoreline Boulevard. Incorporating the long-term vision for North Bayshore, while recognizing the need to make more immediate improvements to this corridor, this study proposes one possible interim concept based on the Precise Plan. It is anticipated that the streetscape design for Shoreline Boulevard north of La Avenida will be further refined, including the potential realignment of the U.S. Route 101 northbound off-ramp and its connection to La Avenida.

The northern extent of the center-running, transit lane would be Plymouth Street. Southbound transit vehicles would enter the center lane at this location from the left-most through lane, while northbound transit vehicles would exit the center lane by transitioning to the through lanes on Shoreline Boulevard. Transit vehicles would get their own signal and phase that functions as a queue-jump treatment and safely facilitates these movements.

The width of the transit lane would be 13 feet, with the lane separated from vehicle lanes by a 5-foot buffer. The Pear Avenue intersection will maintain left turn movements on the northbound approach of Shoreline Boulevard, requiring that the 5-foot buffer be dropped on the north and south intersection approaches.[2]

There are two options for Pear Avenue – one option maintains both of the existing left turn pockets on northbound Shoreline Boulevard, while the second option would drop one of these left turn pockets. Existing peak-hour vehicle counts do not justify two left turn lanes, but future higher-density development may suggest greater demand. The primary tradeoffs between the two options are the impact to right-of-way and adjacent parcels, and increased crossing distances for pedestrians associated with double left turn lanes.

The Pear Avenue intersection incorporates far-side transit stops, both in the median and at curbside. Median transit stops would include a 9-foot platform, and curbside side stops would have an 8-foot sidewalk zone. Basic amenities, such as a shelter, pedestrian-scale lighting, benches, and travel information are recommended for these stops.

Bicycle and pedestrian facilities would be significantly improved in this segment. First, a 13-foot, two-way protected bicycle facility would be implemented on the west side of Shoreline Boulevard all the way to Charleston Road. This two-way facility is also programmed as part of the adopted North Bayshore Precise Plan in order to offer a high-quality facility for bicyclists traveling along Shoreline Boulevard. It also offers a critical connection to and from the bicycle/pedestrian bridge, allowing bicyclists and pedestrians to travel into North Bayshore fully separated from vehicles, while providing a seamless transition to the one-way protected lanes on Shoreline Boulevard south of Terra Bella Avenue. The two-way protected lanes would also be coordinated with pedestrian realm enhancements, in accordance with the guidelines in the North Bayshore Precise Plan. These enhancements include the installation of 12-foot sidewalks, with a minimum 4-foot landscaping zone to plant new trees and landscaping.

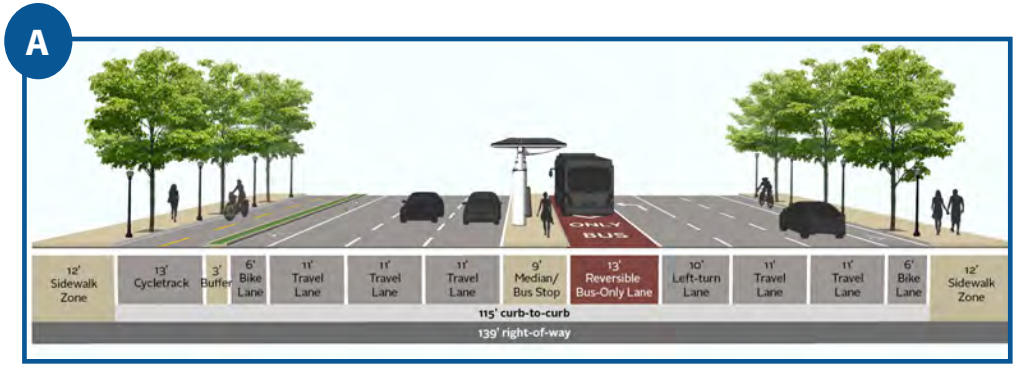
In addition, the existing Class II bicycle lanes would be maintained south of Pear Avenue to provide access to/from the existing bicycle lanes on the U.S. Route 101 overcrossing. These lanes would be expanded to six feet and enhanced with high-visibility markings and signage at key conflict points. The northbound bicycle lane would transition to future bicycle facilities developed as part of the North Bayshore Precise Plan.

Other design features in this segment include:

- Reducing travel lane widths to 11 feet and turn lane widths to 10 feet to encourage slower traffic movement
- High-visibility driveway treatments would be utilized to mitigate conflicts between bicyclists and right-turning vehicles

2 To prevent vehicles from entering the transit lane at Pear Avenue, a narrower buffer/curb (two feet) may be installed.

Space Park Way/Plymouth Street to La Avenida



Shoreline Boulevard at Pear Avenue

This segment includes implementation of the center-running, reversible transit lane on the U.S. Route 101 overpass, requiring the removal of the existing median and trees.[3] The width of the transit lane would be 13 feet and it would be separated from traffic by 18-inch raised buffers on both sides. The existing bicycle lanes would be maintained across U.S. Route 101, but expanded to six feet and enhanced with high-visibility pavement markings and signage, especially at the merge zones to the U.S. Route 101 on-ramps. In addition, the on-ramps would be realigned to tighten the turning radius, reduce vehicle speeds, and mitigate potential conflicts with merging bicyclists and crossing pedestrians.

All travel lanes in this section would be reduced in width to 11 feet with the dual objective of reallocating roadway space to the transit and bike lanes and reducing vehicle speeds. A reduction in vehicle speeds is especially important over U.S. Route 101 where the existing bicycle lanes will not be protected and pedestrians will still utilize the sidewalks and crosswalks near the on- and off-ramps.

South of the U.S. Route 101 overcrossing, the transit lane would be maintained, and additional physical separation would be provided in the form of two 5-foot buffers. The installation of the transit lane in this segment will also require the removal of the existing median and trees. In addition to offering additional separation between the travel lanes, the 5-foot buffers provide adequate space to mitigate tree loss by planting new trees and/or appropriate landscaping.

A key element in this segment is the proposed removal of the left turn lane that provides access to State Route 85 south from the northbound approach of Shoreline Boulevard. Elimination of the left turn pocket at the intersection provides the following benefits:

- Provides adequate space for the center-running transit lane without requiring additional right-of-way.
- Allows for realignment of the off-ramp from southbound U.S. Route 101 to accommodate the alignment for the new bicycle/pedestrian bridge
- Improves both transit travel times and traffic level of service on Shoreline Boulevard due to the elimination of an underutilized signal phase at this location

Access to the State Route 85 southbound at this location has limited utility because it requires vehicles to head north on Shoreline Boulevard to eventually double back south.[4] Access to State Route 85 southbound would still be available via a more direct route on Middlefield Road and Moffett Boulevard, a short distance from the existing Shoreline Boulevard on-ramp. Closure of this turn lane would not affect access to U.S. Route 101 or access to State Route 85 from North Bayshore.

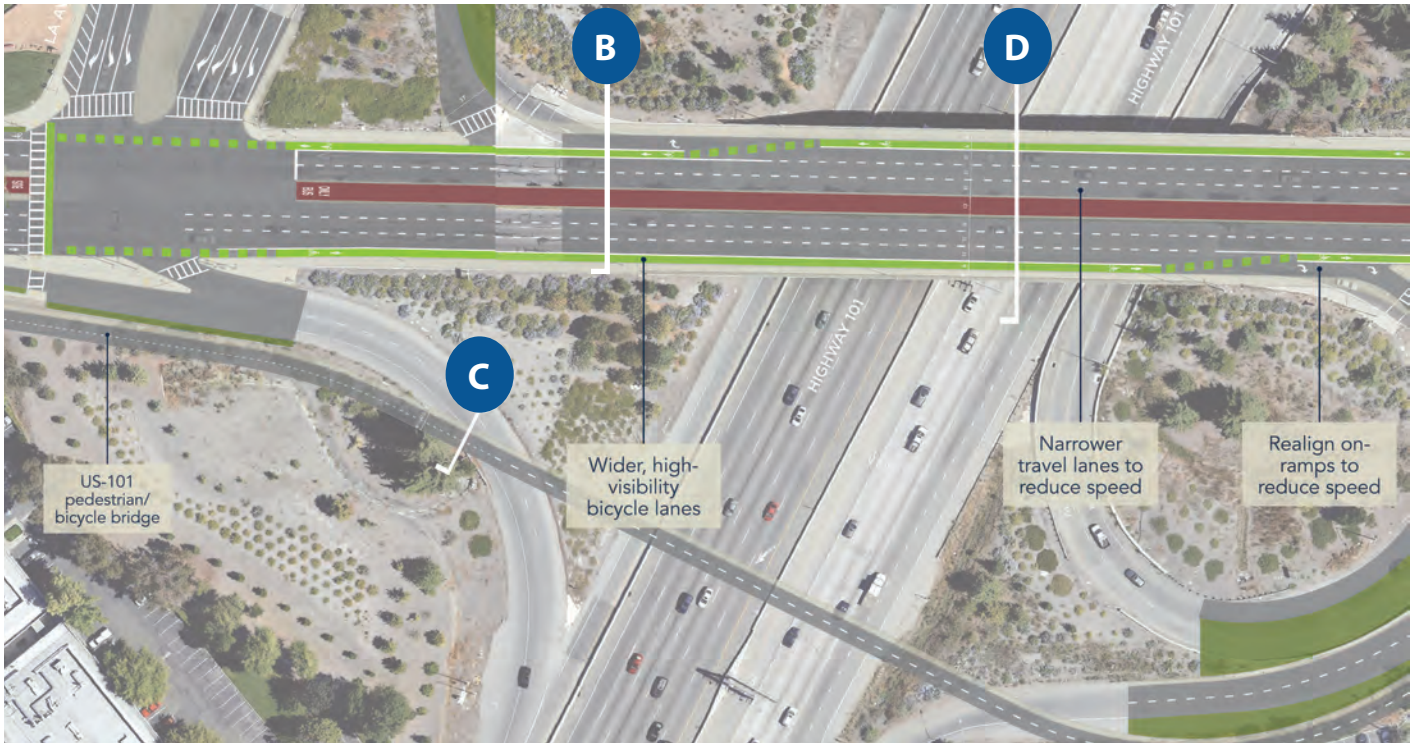
Class II bicycle lanes would also be maintained in the segment between U.S. Route 101 and Terra Bella Avenue, but expanded to six feet. As discussed in greater detail below, a two-way protected bicycle facility would be provided on the west side of Shoreline Boulevard, north of Terra Bella Avenue. This facility provides a transition from Shoreline Boulevard to the proposed bicycle/pedestrian bridge.

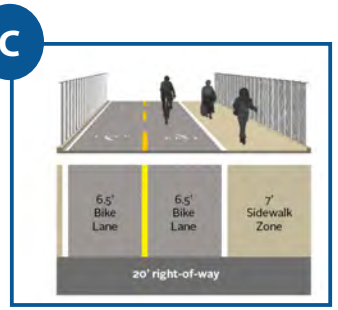
Existing bicycle lanes would be maintained across U.S. Route 101, but expanded to six feet and enhanced with high-visibility pavement and signage. The on-ramps would be realigned to tighten the turning radius, reduce vehicle speeds, and mitigate potential conflicts with merging bicyclists and crossing pedestrians.

3 Approximately 80 median trees will be removed between Terra Bella Avenue and Plymouth. None of these trees appear to meet the City's heritage tree classification.

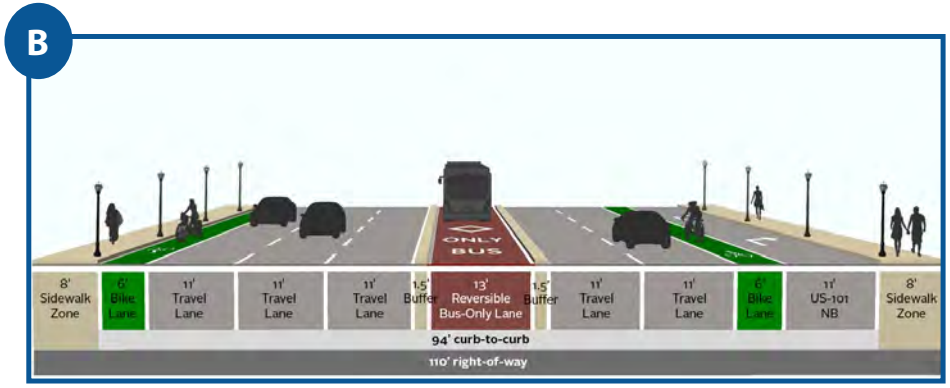
4 Existing traffic counts indicate that approximately 100 vehicles are making this left turn during peak periods.

La Avenida to Terra Bella Avenue

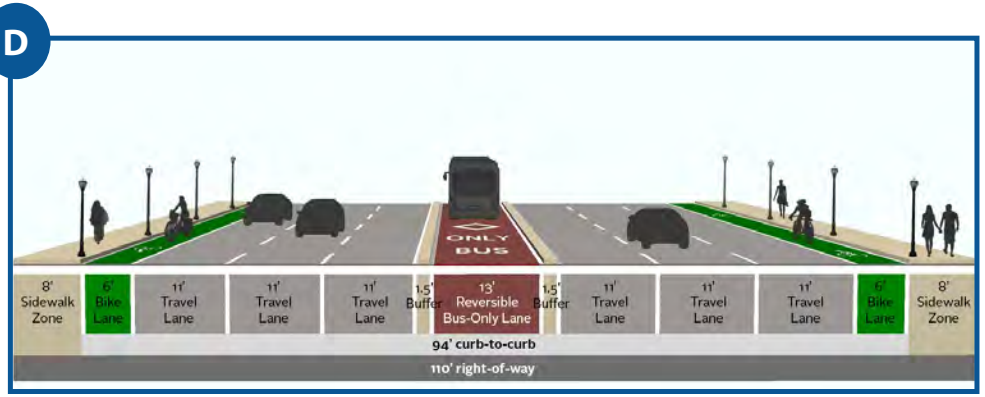




Bicycle and Pedestrian Bridge

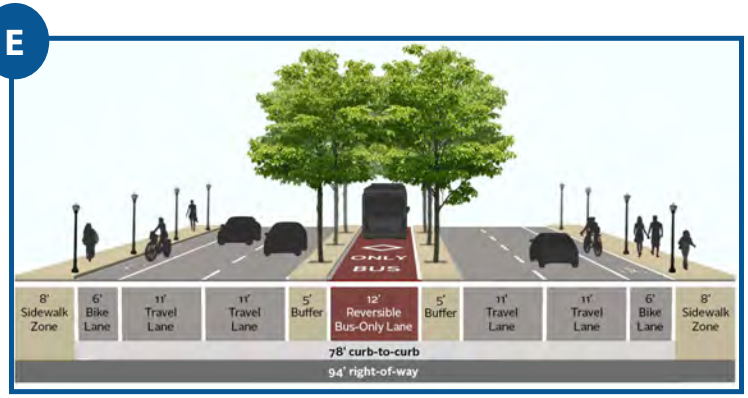


US-101 Overcrossing (at La Avenida)



US-101 Overcrossing

La Avenida to Terra Bella Avenue (cont.)



Shoreline Boulevard at 101 Overcrossing (Southside)

U.S. Route 101 Bicycle/Pedestrian Bridge

U.S. Route 101 presents a major challenge for multi-modal travel in the Shoreline Boulevard corridor. The existing overpass provides minimal accommodation for bicyclists and pedestrians, while the high vehicle speeds and challenging crossings largely deter travel by these modes. To improve access across U.S. Route 101, modifications to the existing bicycle lanes are proposed on the preceding page. However, a separated facility is needed to significantly improve safety, make Shoreline Boulevard a desired route, and attract bicyclists of all ages and abilities.

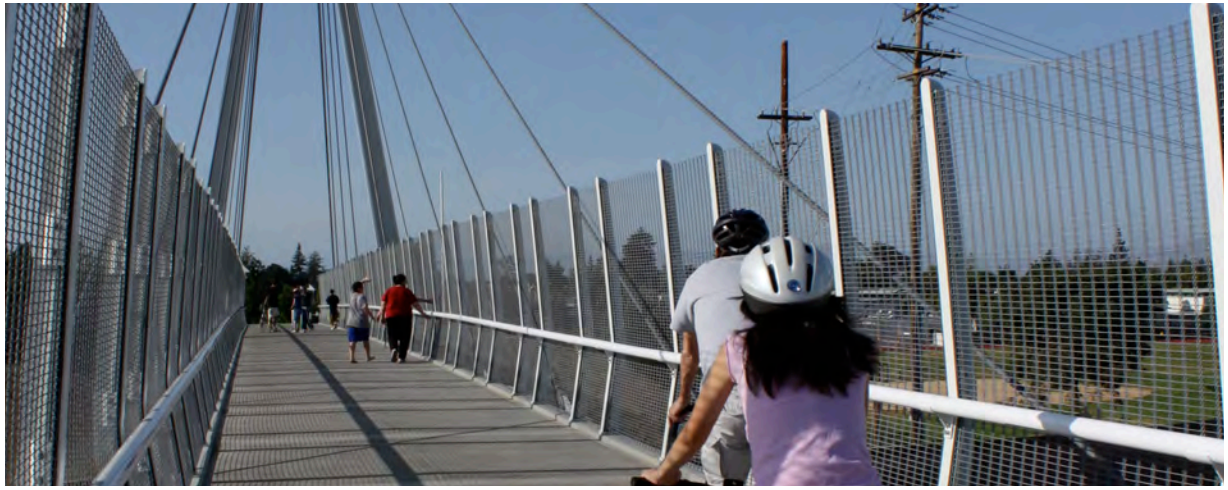
The bicycle and pedestrian bridge over U.S. Route 101 provides that physical separation, as well as an interesting and attractive experience. A number of options exist for the design of the bridge. One option would be a bridge similar to the Permanente Creek Trail Extension bridge over U.S. Route 101 (opened in 2012) that required a center support column in the freeway median. Another option is a clear span bridge that would not require columns within the median. A third option could include a specialty design, such as a suspension bridge.

The bridge would provide two seven-foot lanes for bicycles and a six-foot lane for pedestrians (20 feet total width), as shown in Section C. These widths should provide adequate space for bicyclists to pass and a comfortable walking environment for pedestrians. The bicycle and pedestrian lanes would be at the same grade and no curb would be used to delineate between the bicycle and pedestrian space. However, pavement markings, materials, and signage could all be utilized to indicate direction of travel and separation of modes.

The bridge would transition from a two-way protected bicycle lane on the west side of Shoreline Boulevard (beginning north of Terra Bella Avenue) and follow the available right-of-way adjacent to Shoreline Boulevard and the U.S. Route 101 southbound off-ramp. As previously described, it is proposed that the left turn to State Route 85 be closed at this location to allow for the off-ramp to be reconfigured to better accommodate the bridge. The bridge would ramp up shortly after it turns to the west away from Shoreline Boulevard. It would then turn north and the alignment would straighten as it crosses over U.S. Route 101.

On the north side of the U.S. Route 101, the bridge would touch down in what is existing Caltrans property just to the west of U.S. Route 101 northbound on-ramp. The bridge alignment here has been configured to minimize impacts to this parcel. The bridge would ramp down on the west side of Shoreline Boulevard and then transition into the two-way protected bicycle lane proposed for the North Bayshore area.

The recently completed Permanente Creek bridge over U.S. Route 101.
Image from Mark Thomas & Co



The Mary Avenue Bridge over I-280 in Cupertino is a cable-stayed bridge.
Image from Flickr, Naotake Murayama

Terra Bella Avenue to Middlefield Road

The Terra Bella Avenue intersection provides the recommended transition point from Shoreline Boulevard's one-way protected bicycle lanes to the south and the bicycle/pedestrian bridge. This intersection would require signal modification to implement a "scramble" phase for pedestrians and bicyclists. This phase essentially stops all vehicle movements and allows for simultaneous pedestrian and bicycle crossings at all legs of the intersection. The scramble phase would primarily facilitate a diagonal crossing for northbound bicyclists to the two-way protected lanes and bridge. Southbound bicyclists would utilize the mixing zone at the northwest corner to access the southbound protected lane on Shoreline Boulevard. If desired, northbound bicyclists could continue north through the intersection and utilize the existing Class II bicycle lanes to cross U.S. Route 101.

The Terra Bella Avenue intersection also incorporates far-side transit stops, both in the median and at curbside. Median transit stops would include a 9-foot platform and curbside side stops would have an 8-foot sidewalk zone. Basic amenities, such as a shelter, pedestrian-scale lighting, benches, and travel information are recommended for these stops.

The intersection will maintain the existing left turn pockets, requiring that the transit lane buffer be dropped on the north and south intersection approaches.[5] The transit lane will resume its 13-foot width and 5-foot buffers south of Terra Bella Avenue to Middlefield Road. As a result, the two-way left turn lane will be eliminated for this one block of Shoreline Boulevard, requiring vehicles to make u-turns at either Terra Bella Avenue or Middlefield Road to access the other side of Shoreline Boulevard.

South of Terra Bella Avenue, one-way protected bicycle lanes would be implemented in both directions. The recommended width for these lanes is 6.5 feet to ensure there is adequate passing room. A 6-foot buffer would separate the lane from vehicles and provide adequate room to plant trees or low-level landscaping.

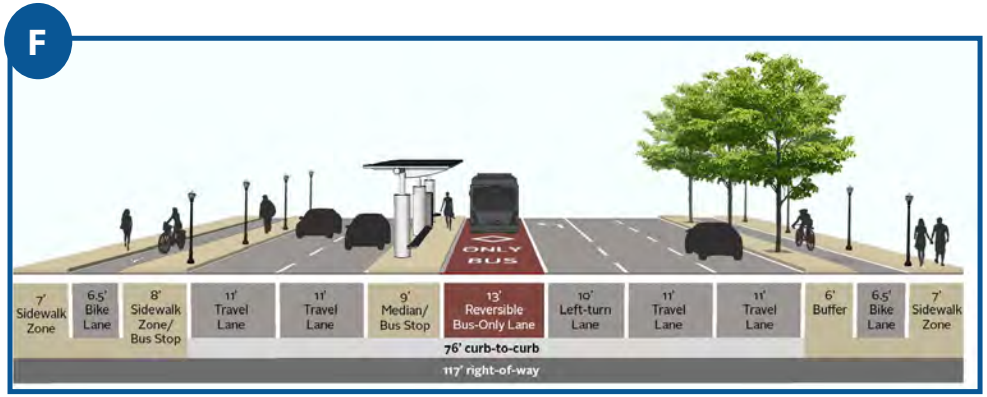
Other proposed design features in this segment include:

- Reducing travel lane widths to 11 feet
- Expanding the sidewalks to a minimum of seven feet, with enhanced lighting and aesthetic treatments
- Installing high-visibility driveway treatments to mitigate conflicts between bicyclists and right-turning vehicles
- Modifying or reconstructing property access adjacent to the Middlefield Road intersection to improve conditions at challenging conflict points for bicyclists on both Shoreline Boulevard and Middlefield Road.

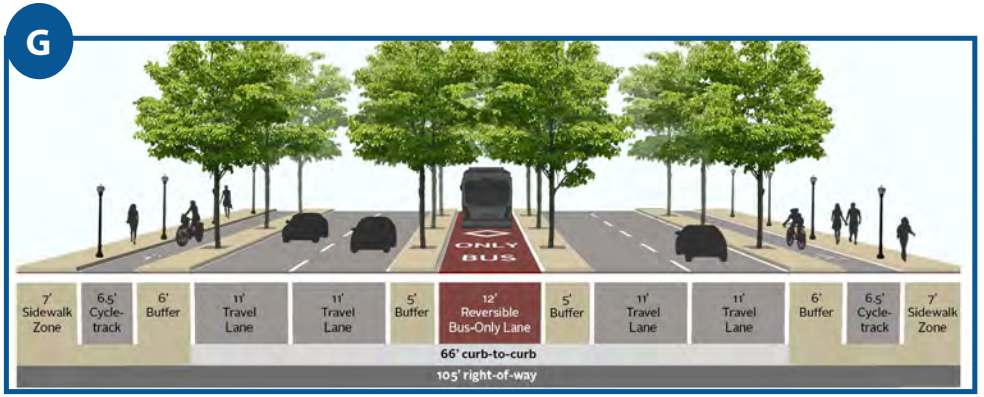
5 To prevent vehicles from entering the transit lane at this location, a narrower buffer/curb (two feet) may be installed

The one-way protected bicycle lanes would transition to two-way protected lanes at Terra Bella.

Terra Bella Avenue to Middlefield Road



Shoreline Boulevard at Terra Bella Avenue



Shoreline Boulevard (Terra Bella Avenue to Middlefield Road)

The Middlefield Road intersection would be transformed to offer improved conditions for bicyclists, pedestrians, and motorists. The existing configuration has very long crossing distances, enables vehicle right turns at high speeds, and provides little accommodation for bicyclist and pedestrian movements. Furthermore, intersections are recognized as having the most conflicts point with bicyclists and pedestrians, and it is especially important to effectively manage the movements of bicyclists from protected bicycle lanes at intersections.

The proposed changes offer a "protected" environment for those on bike or who are walking. The operation of this type of intersection is described in more detail (Figure 4-2), but its primary goal is to increase the visibility of pedestrians and bicyclists, while providing them a designated path by which to safely navigate the intersection. Two important features to be highlighted are that bicyclists and pedestrians will get their own signal phase and that vehicles will be prohibited from turning right on a red light.

Middlefield Road is also the southern extent of the center-running transit lane. Northbound transit vehicles would enter the lane at this location from the left-most through lane, while southbound transit vehicles would exit the center lane here either by turning left onto Middlefield Road or transitioning to the through lanes on Shoreline Boulevard. Transit vehicles, as illustrated in Figure 4-3, would get their own signal and signal phase to safely facilitate these movements.

South of Middlefield Road, the one-way protected bicycle lanes would continue all the way to Stierlin Road/Montecito Avenue with similar design elements as north of Middlefield Road. The center left-turn lane would be preserved, as well as access to almost all existing driveways. A connection for bicyclists and pedestrians to Stierlin Road would be provided via the existing slip lane (for northbound movements) and improvements at the Stierlin Road/Montecito Avenue/Shoreline Boulevard intersection (for southbound movements), as described later in this report.

This segment of Shoreline Boulevard also includes the potential installation of an additional signalized crossing for pedestrians. The distance between Stierlin Road/Montecito Avenue and Middlefield Road intersections is more than ¼ mile and there are no marked pedestrian crossings. Given this distance, pedestrians are unlikely to walk up to ten minutes out of their way to cross Shoreline Boulevard at a signalized crossing. The result is that pedestrians regularly jaywalk across this high-speed arterial in order to go to and from the nearby Bailey Park Plaza shopping center. In the last five years, there have been three pedestrian-vehicle collisions on Shoreline Boulevard in this area.

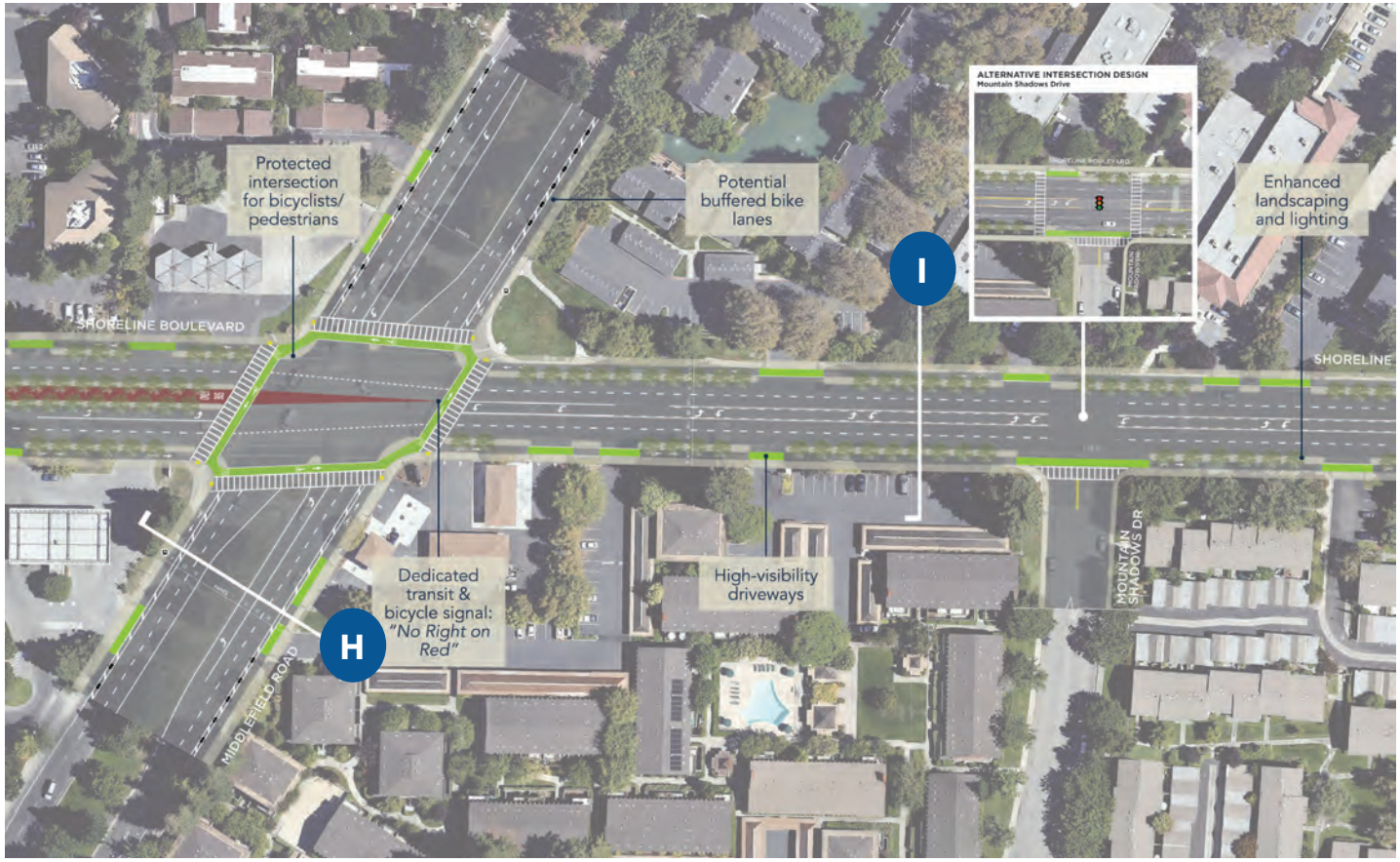
To address this concern, the designs show three potential options: a fully signalized intersection at Mountain Shadows Drive, a fully signalized intersection near the shopping center and the Buddhist Temple, and a pedestrian-activated crossing near the shopping center. These options would be further evaluated and a preferred option selected in the future design and engineering phase.

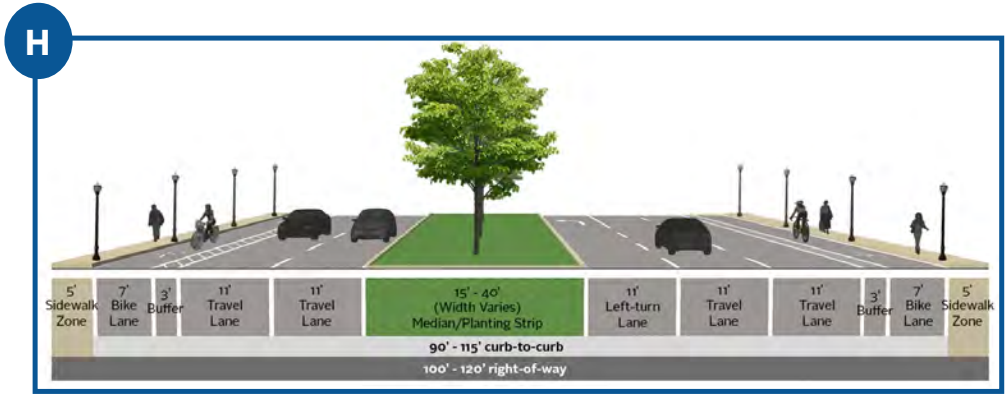
Other design features in this segment include:

- Reducing travel lane widths to 10.5 or 11 feet
- Expanding the sidewalks to a minimum of seven feet, with enhanced lighting and urban design treatments
- Utilizing high-visibility driveway treatments to mitigate conflicts between bicyclists and right-turning vehicles
- Realign and reconfigure driveways at the Middlefield Road intersection, while retaining adequate access.

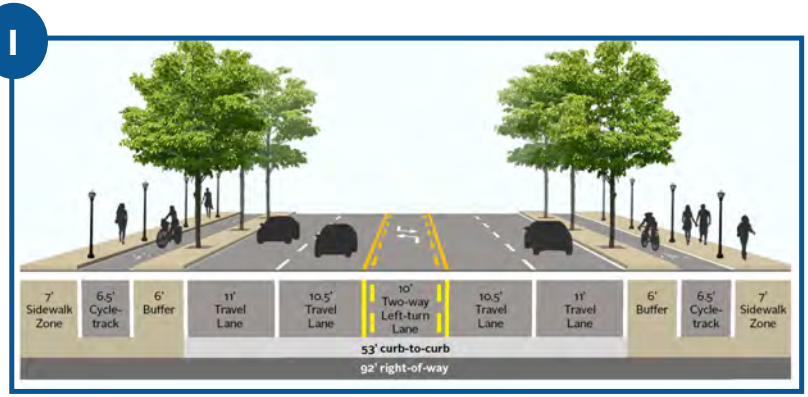
This segment of Shoreline Boulevard includes the potential installation of an additional signalized crossing for pedestrians. The distance between intersections is more than ¼ mile and there are no marked pedestrian crossings. Pedestrians are unlikely to walk up to ten minutes out of their way to cross Shoreline Boulevard at a signalized crossing.

Middlefield Road to Stierlin Road



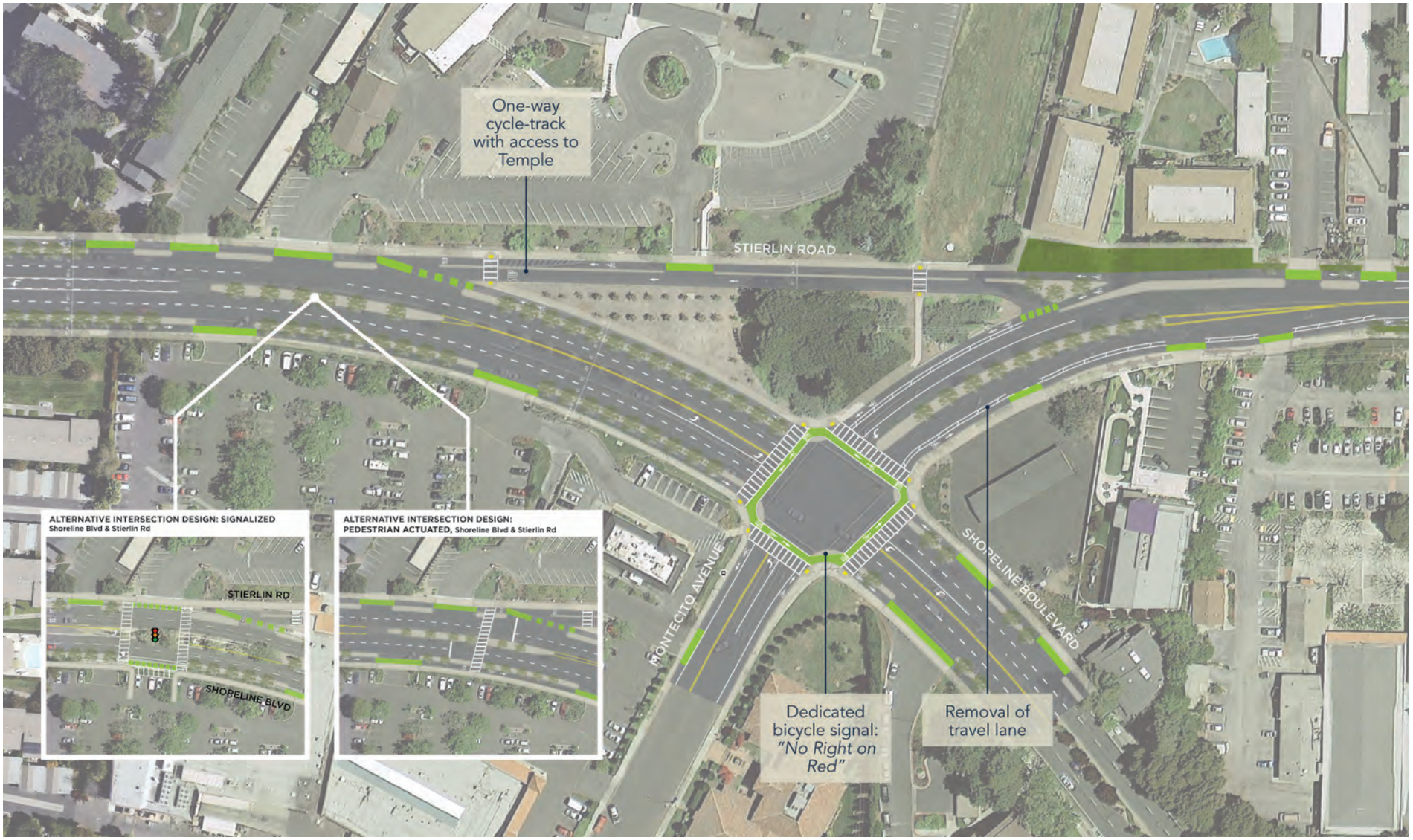


Middlefield Road (West of Shoreline)



Shoreline Boulevard at 101 Overcrossing (Southside)

Middlefield Road to Stierlin Road (cont.)



Middlefield Road

Middlefield Road is a key route in the city's bicycle and pedestrian network, especially because it offers a direct connection to and from the Permanente Creek trail – one of the city's most popular bicycle and pedestrian facilities and a crucial access point into North Bayshore. Middlefield Road currently has Class II bicycle lanes.

Middlefield Road itself was not a primary focus of this study, but some preliminary concepts were developed as a potential interim phase to improve this key route. One potential low-cost alternative to make some immediate improvements to Middlefield Road is shown on the preceding pages in Section H. Travel lanes would be reduced to 11 or 12 feet to allow an expansion of the existing bicycle lanes to seven feet and the striping of a 3-foot buffer. At a minimum, the buffer would include interior diagonal cross-hatching, but vertical separation (such as flexible bollards) could also be considered.

The 2015 Bicycle Transportation Plan Update will more comprehensively address improvements to bicycle facilities on Middlefield Road. In the interim, striping changes and the implementation of a buffered lane would offer significant improvements to this crucial route.

Shoreline Boulevard, south of Stierlin Road/Montecito Avenue

The sout hern extent of Shoreline Boulevard included in this study is the intersection of Stierlin Road/Montecito Avenue. The City is currently engaged in a separate effort to evaluate improvements and streetscape changes to Shoreline Boulevard south of Stierlin Road/Montecito Avenue. The California/Escuela/South Shoreline Boulevard study is evaluating the feasibility of Complete Streets options for Shoreline Boulevard between Montecito Avenue and El Camino Real. That study, as well as the 2015 Bicycle Transportation Plan Update, will prioritize improved connections to the larger network from Shoreline Boulevard.

Reversible Transit Lane

A prominent feature of the proposed improvements is the center-running, reversible transit lane. The reversible transit-only lane is recommended for approximately three-fifths of a mile in the median of Shoreline Boulevard, from Middlefield Road north to Plymouth/Space Park Way in North Bayshore. It would consist of a single lane used by northbound buses on weekday mornings and by southbound buses on weekday afternoons. It would feature center and curb-side stops at Terra Bella Avenue and Pear Avenue. In addition to North Bayshore transit service, regular VTA routes and other shuttle services would be eligible to use the lane, as well as emergency vehicles. Use of the transit lane by automobiles (including carpools) would be prohibited for the following reasons:

- **Congestion/Travel Time:** The projected volume of transit vehicles, especially in the peak period, would preclude use of the lane by carpools since allowing them into the lane would negatively impact transit travel time and degrade the value of the lane.
- **Safety:** Effective and safe use of the transit lane will require trained drivers who are experienced with transitions in and out of the transit lane, dedicated transit signals, and vehicle operation next to a permanent, vertical buffer, as well as the median bus platforms.
- **Operational costs:** The median lane would require additional operational costs to ensure proper enforcement of access to the lane.

Dedicated signalization and signage at intersections will be used to control entry and exit into the transit lane.
Image from Flickr, streetcar.press

Because the transit lane would be reversible and change directions at various points during the day, effective implementation also includes the following operational guidelines:

- **Dedicated transit signals** at Middlefield Road and Plymouth Street to facilitate transitions in and out of the transit lane. A key component of the signal phasing at the intersections with the transit lane is the use of a fully protected left-turn phase, which requires dedicated left-turn lanes. As described by APTA Recommended Practice: Designing Bus Rapid Transit Running Ways: "While the left-turn phase requires stopping the oncoming traffic and all traffic in the busway, application of transit signal priority technology can help to minimize delays for buses by ensuring that the left-turn phase is not activated when a bus is approaching the intersection. It is also common to pair a left-turn lane leading up to an intersection with a far-side BRT station, such that the station platform is located 'in the shadow' of the left-turn lane, taking advantage of the extra width required for the station to also accommodate a dedicated left-turn lane."[6] This guidance is reflected in the designs for Shoreline Boulevard.
- **Physical barriers** to prevent vehicles from entry into the lane. A minimum of 18 inches is required, but five-foot landscaped buffers are recommended and preferred.

6 http://www.apta.com/resources/standards/Documents/APTA-BTS-BRT-RP-003-10.pdf

The median transit lane would be delineated by a combination of pavement markings and physical barriers.
Left image from Flickr, Chris Phan

- **Pavement markings** should be in accordance with the guidance of the California Manual on Uniform Traffic Control Devices (MUTCD). Pavement would be colorized red, at a minimum at intersections and transition areas, and "Bus Only" markers would be stenciled onto the pavement at those locations.
- **High-visibility "Do Not Enter" signage** would be installed overhead at all intersections. In addition, overhead signs should also be installed at intervals of about 15-30 seconds based on traveling at the posted speed.
- **A "clearing" period** would be required prior to the shift in direction to ensure that all vehicles have exited the lane.
- The minimum recommended **vertical clearance** is 15.5 feet, ensuring that maintenance and emergency vehicles could also utilize the lane.
- **Maintenance and emergency vehicles** would be able to utilize the lane as needed and only if safe operations are maintained. Vehicles would enter/exit the lane at the intersections or designated locations.

The proposed reversible transit-only lane could be implemented in two or possibly three phases. In the first phase, the lane itself might be developed between Pear Avenue and Middlefield Road, but without the planned stops at Terra Bella Avenue and Pear Avenue. On an interim basis, prior to construction of the side medians, other elements might be used to separate the lanes from traffic. Ideally, these would be vertical delineators such as mountable curbs or rubber bumpers, which would reduce the risk of head-on collisions by physically excluding non-permitted vehicles from the lanes. Alternately, some combination of striping and ceramic markers could be used, consistent with the MUTCD.

If the lane were delineated using striping or a curb/vertical element rather than side medians with plantings, it could be implemented with more limited expansion of the right-of-way, as the lane would largely take the place of the existing landscaped median on the U.S. Route 101 overpass and the two-way left-turn lane south of Terra Bella Avenue. However, for the existing left-turn lanes at Terra Bella Avenue to be retained, the roadway would have to be expanded at this location. Additionally, new transit-only signal phases and detectors would be required at Pear Avenue in the northbound direction and at Middlefield Road in the southbound direction, in order to allow buses to go ahead of and safely merge across traffic to the right. If improvements at the intersections are delayed, it is possible that the lane could begin north of Middlefield Road as an interim design solution. This concept would need to be further evaluated to ensure safe operation of the median lane.

If the initial delineation consisted solely of striping, an interim phase might be added in which the striping was replaced by vertical separation, and the lane itself was colorized. Alternately, these measures could be implemented in the first phase.

In the final phase, the lane would be extended north to Plymouth Street, and the planned median stops would be added at Terra Bella Avenue and at Pear Avenue. The final phase would also include installation of the full 5-foot landscaped buffers along the transit lane. This would require additional right-of-way and reconfiguration of adjacent travel lanes at stops. However, impacts on transit from construction could be limited, as work would take place outside of the envelope of the existing transit lane itself and/or during periods when the lanes were not in use. This phase would likely be implemented in conjunction with the final protected bicycle lane improvements.

Transit Stops

Median and curbside far-side transit stops are proposed at Terra Bella Avenue and Pear Avenue. Far-side stops allow transit vehicles to proceed through the intersection before loading and unloading passengers. Far-side stops maximize the degree to which a bus can utilize the green phase at a signalized intersection. They also allow for easier re-entry into the travel lane by allowing buses to utilize the natural breaks in traffic created by the signal they just passed.

One downside to far-side stops is that they can cause backups into the intersection if motorists queue behind the buses. However, the median platform recommended for Shoreline Boulevard is 80 feet in length a, which would allow for two 40-foot vehicles to load at the same time, but could accommodate three to four smaller buses or shuttles at one time. The 9-foot wide median platform would be adequate space for waiting passengers and offer ample room to provide a shelter, lighting, benches, and other passenger amenities (maps, schedules, or real-time arrival information). It is also recommended that the platform provide ticket vending machines to allow passengers to purchase tickets prior to boarding, thereby reducing dwell times. Depending on the vehicle type, the platform could also enable level boarding to further improve travel times.

The curbside stops proposed for Pear Avenue and Terra Bella Avenue would accommodate all non-peak travel loads (northbound in the P.M. and southbound in the A.M.). The recommended width of the curbside stops is eight feet. Stops should include minimum amenities, such as signage, bench, shelter, and real-time passenger information.

Transit stops will include shelter, lighting, benches, and other high-quality passenger amenities.
Images from Flickr, ITDP (top); Flickr, Chris Phan (bottom L); Flickr Oran Viriyincy (bottom R)

U.S. Route 101 Bicycle/Pedestrian Bridge

The 2013 Shoreline Transportation Study proposed the concept of a new bridge over U.S. Route 101 for transit, bicyclists, and pedestrians. The conceptual alignment identified a route to the west of the existing bridge, largely due to more significant right-of-way and ramping challenges on the east side. This concept was further evaluated and analyzed as part of this study. Based on the preliminary screening, it was determined the western route still offered the best alignment, but that the bridge should only be designed for pedestrians and bicyclists, primarily because the proposed center transit lane on Shoreline Boulevard would eliminate the need to divert transit vehicles onto the bridge.

The proposed alignment and elevation are conceptual in nature. The concepts provide a basic framework for the bridge alignment and conform to the key design criteria that follow. The next stage for the project would include detailed design and engineering, and also respond to any City and/or Caltrans requirements for distinct architectural features.

It is important to note that the bridge alignment falls within Caltrans right-of-way. A key step in the next phase of this project will be detailed discussions with Caltrans about the alignment and its right-of-way impacts, particularly near the on- and off-ramps on both sides of U.S. Route 101. Final designs will likely need to accommodate potential future widening of the on- and off-ramps.

The proposed bridge concept is based upon the following design criteria, which would guide the detailed design and engineering.

- Maximum pathway profile grade (without landings): 4.9%
- Minimum vertical clearance from top of roadway to overcrossing: 18 feet 6 inches
- Overcrossing walkway width: 18 feet minimum, 20 feet proposed
- Approach ramp walkway width: 18 feet minimum, 20 feet proposed
- Minimum fence height (over Route 101): 8 feet
- Minimum fence height: 42 inches
- Design speed (bicycles): 25 miles per hour
- Minimum fence opening above U.S. Route 101: 1″x 1″

The following Caltrans standards for U.S. Route 101 during bridge construction activities must also be considered:

- Minimum falsework traffic opening width over U.S. Route 101: 72 feet
- Minimum vertical falsework clearance over U.S. Route 101: 15 feet

According to the Americans with Disabilities Act (ADA), a path with a slope greater than 5% is defined as a ramp. The maximum allowable slope is 8.33% and ramps must provide a level landing for every 30 inches of elevation rise. Furthermore, Title 24 California Code of Regulations (CCR) states that walkways with continuous gradients (slopes between 2-5%) shall have level areas (2% max) at least five feet in length at intervals of at least every 400 feet.

Caltrans Highway Design Manual (HDM) also requires that bicycle lanes on overcrossing structures should be a minimum width of 8 feet, and it is desirable to match the clear width of the approaching path. Valley Transportation Authority (VTA) Bicycle Technical Guidelines encourage a minimum effective trail width of 10 feet. For this project, a minimum width of 20 feet is proposed for the trail approach ramps and the overcrossing due to the fact that a separated pedestrian travel area is desired and a high volume of pedestrian and bicycle users are anticipated to use this facility.

Loading for the bridge will be designed in accordance with the American Association of State Highway and Transportation Officials (AASHTO) Load and Resistance Factor Design Guidelines for Design of Pedestrian Bridges.

Protected Bicycle Lanes

A prominent feature of the preferred package of corridor improvements is the one-way protected[7] bicycle lanes on Shoreline Boulevard. The proposed design includes 6.5 foot lanes, providing the minimum standard to ensure adequate room for bicyclists to pass. Adjacent to the bicycle lane is a 6-foot buffer, providing substantial physical separation from the fast moving vehicle traffic on Shoreline Boulevard and adequate room for a robust tree and landscaping plan.

These would be the first protected bicycle lanes in Mountain View, yet they have already been shown to be highly effective in many cities and are rapidly being implemented in cities across the country. The National Association of City Transportation Officials (NACTO) developed the Urban Bikeway Design Guide,[8] which provides jurisdictions with guidelines and best practices regarding the development of protected bicycle lanes. Recently adopted legislation in California (AB 1193) requires Caltrans to establish engineering guidelines for protected bicycle lanes and also allows cities to adopt non-Caltrans guidelines (such as NACTO) as their citywide design standards. Caltrans recently endorsed the NACTO guidelines and is working to integrate them in the Highway Design Manual. Protected bicycle lanes no longer require a special experimentation process via FHWA.

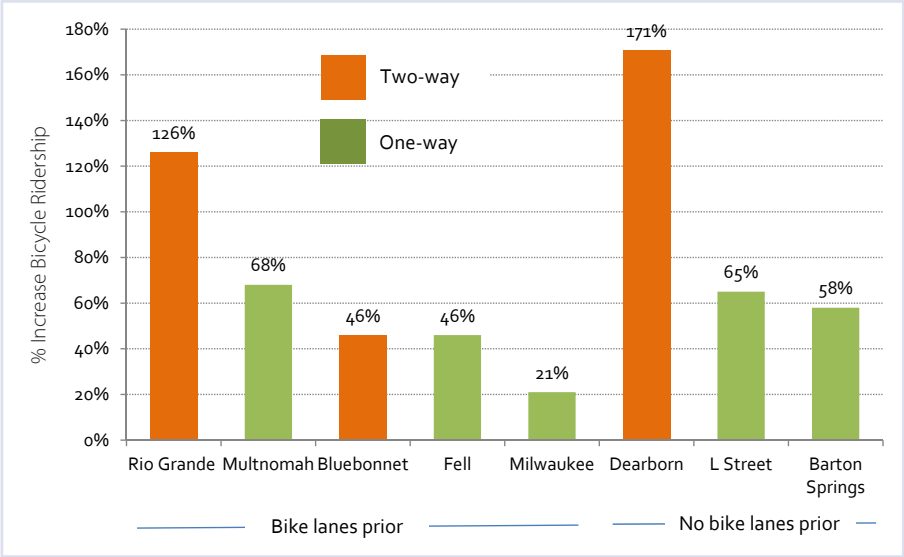
Research has consistently demonstrated that protected bicycle lanes have many benefits. First, they are much safer than having no lanes or conventional bicycle lanes.[9] Exposure to harmful particulate matter is also much lower in protected lanes than in conventional lanes.[10] Second, they increase bicycle ridership by eliminating the primary barrier to lower skill riders – safety concerns due to riding in a shared lane or directly adjacent to a travel lane.[11,12,13] Motorists also prefer protected bicycle lanes because they increase their perception of safety and comfort level when driving near bicyclists.[14] Finally, bicycle infrastructure, particularly protected lanes, results in increased economic activity and perceptions of quality of life.[15,16]

The recently completed protected bicycle lanes on Rosemead Avenue in Temple City, CA offer one example for Shoreline Boulevard.

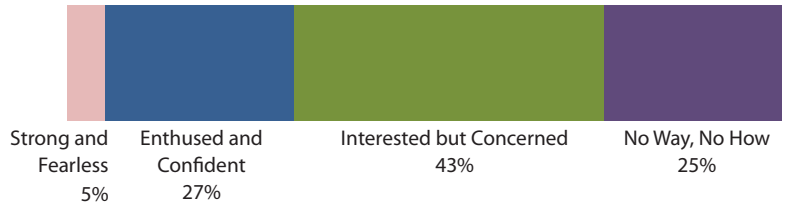
Top image from Flickr, waltarrrrr

7 Also known as cycle tracks or Class IV bikeways in California (per AB 1193).
8 http://nacto.org/cities-for-cycling/design-guide/
9 http://www.streetsblog.org/wp-content/uploads/2014/09/2014-09-03-bicycle-path-data-analysis.pdf
10 http://www.otrec.us/project/345/
11 http://otrec.us/project/583
12 http://www.cts.pdx.edu/pdf/Dill%20CTS%20Friday%20Seminar%205-16-08.pdf
13 http://usa.streetsblog.org/wp-content/uploads/2013/08/296-2022-1-PB.pdf
14 http://usa.streetsblog.org/2013/06/13/in-california-cities-drivers-want-more-bike-lanes-heres-why/
15 http://otrec.us/project/583
16 http://www.nyc.gov/html/dot/downloads/pdf/dot-economic-benefits-of-sustainable-streets.pdf

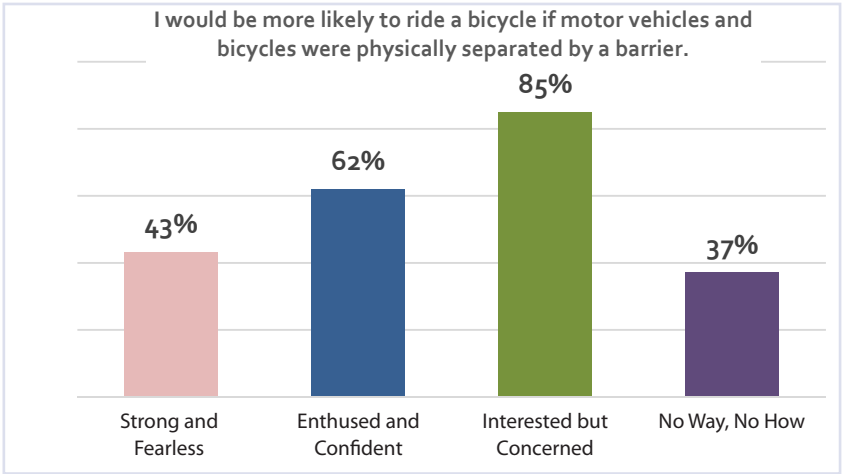
Protected bicycle lanes have resulted in substantial increases in ridership.
Image from "Lessons from the Green Lanes: Evaluating Protected Bike Lanes in the U.S." NITC, June 2014.



Without Protected Bike Lanes



With Protected Bike Lanes



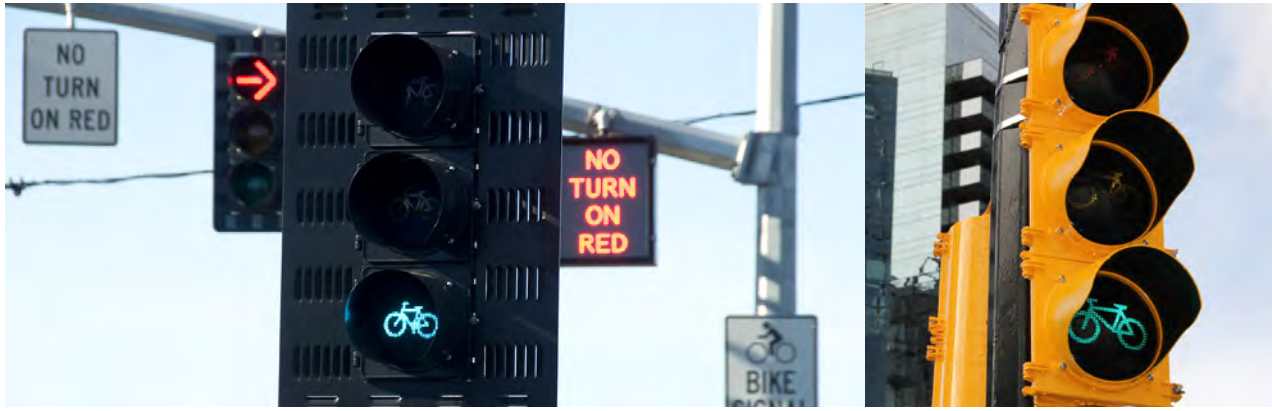
Protected bicycle lanes increase an individual's likelihood of biking, regardless of their interest or ability..
Image adapted from "Lessons from the Green Lanes: Evaluating Protected Bike Lanes in the U.S." NITC, June 2014.

Protected Intersections

Intersections are the most dangerous place for bicyclists and pedestrians because the myriad of potential movements creates many potential conflict points. Intersections are particularly challenging with protected bicycle lanes. While bicyclists can be separated from vehicles with a barrier in mid-block locations, the physical buffer must be dropped through the intersection. Right-turning vehicles present the most common conflict at these points. One design option is to drop the physical buffer well ahead of the intersection and implement a "merge" or "crossover" zone between motorists and bicyclists, requiring shared use of the lane. However, dropping the buffer on approach undermines a bicyclist's sense of security and comfort.

An alternative design approach is to keep bicyclists separated for as long as possible by bringing the physical barrier all the way to, and partially into, the intersection, creating a "protected" environment.[17] Figure 4-2 highlights how a bicyclist might proceed through the intersection with right, left, and through movements. Key components of the protected intersection design include:

- Designated and distinct crossing zones for bicyclists and pedestrians, which require crosswalks to be moved back from the intersection
- High-visibility crosswalks for pedestrians and high-visibility pavement markings for bicyclists to clearly define the route that should be taken through the intersection and reduce potential conflicts between pedestrians and bicyclists



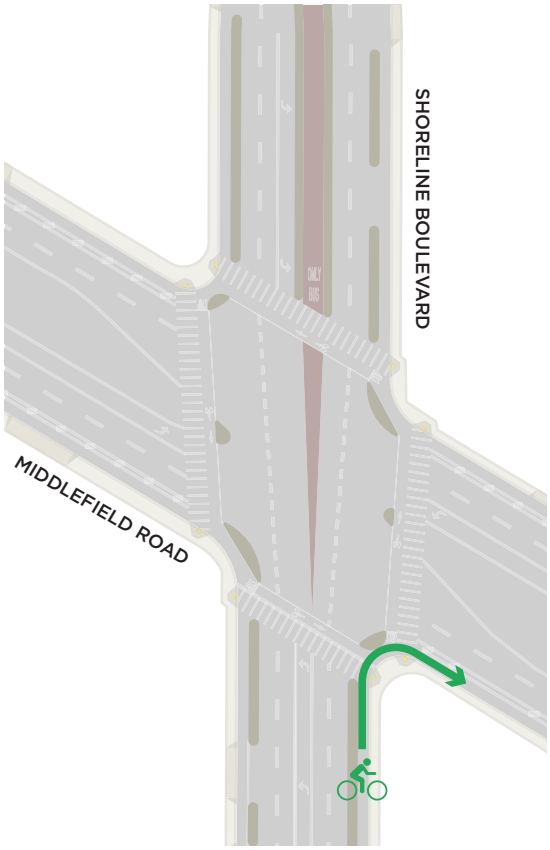
A dedicated signal phase for bicyclists will safely facilitate movements through intersections and mitigate right-turn conflicts. Images from Flickr, Oregon DOT (top); Flickr, Paul Krueger (right)

- Advance stop lines for bicyclists, which position them in front of motorists and make them more visible.
- Corner refuge islands offset from the corners of the intersection of the intersection to: 1) provide a protected space for bicyclists waiting to go straight or turn left; 2) require right-turning drivers to be perpendicular to the bicyclist and pedestrian path of movement, thereby increasing visibility.
- A separate signal phase providing a leading interval for bicycles and pedestrians, which allows bicyclists and pedestrians to get out ahead of right-turning motorists and mitigate right-turn conflicts. (This phasing requires "No Right Turn on Red" for motorists and is illustrated in Figure 4-3).
- Additional bicycle signal design elements, as described in the *NACTO Urban Bikeway Design Guide*, including:[18]
  - Utilizing general MUTCD standards for traffic signals (i.e. positioning, aiming, shielding, etc.)
  - Placing signal heads near- and far-side to increase visibility
  - Differentiating bicycle signal heads with distinct coloring (typically yellow) and additional signage
  - Providing an adequate clearance interval for bicyclists and pedestrians
  - Setting the bicycle/pedestrian phase to recall on each cycle, or using passive actuation for bicyclists through in-pavement inductive loops or video/microwave detection
  - Utilizing highly visible "No Turn on Red" signage for motorists

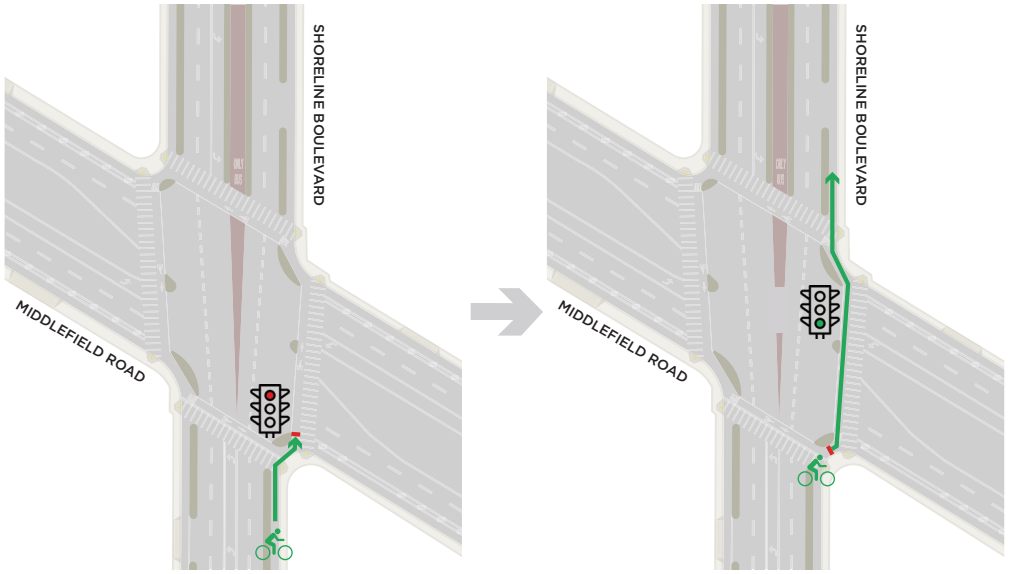
17 This design concept is also known as a "Dutch" intersection, and has been further developed and advocated for in the American context by Nick Falbo. Additional detail can be found at www.protectedintersection.com.

18 http://nacto.org/cities-for-cycling/design-guide/bicycle-signals/bicycle-signal-heads/

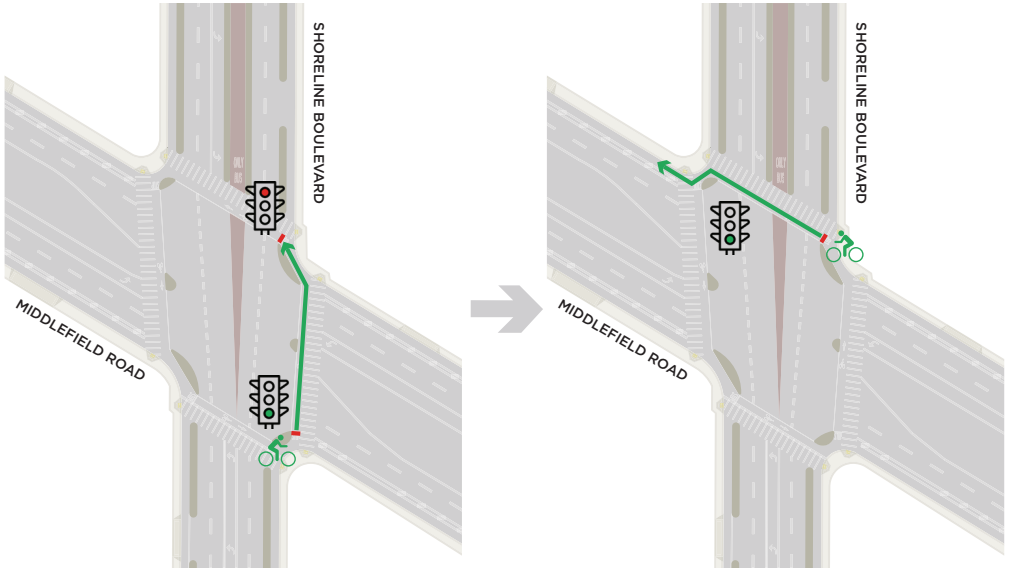
FIGURE 4-2 EXAMPLE BICYCLE MOVEMENTS AT PROTECTED INTERSECTIONS (MIDDLEFIELD ROAD)



Right-turn (NB Shoreline Blvd to EB Middlefield Rd)



Through movement (Shoreline Blvd)



Two-stage left-turn (NB Shoreline Blvd to WB Middlefiled Rd)

High-visibility pavement markings and signage are essential to mitigating conflicts at driveways.
Images from Flickr, People-ForBikes (top); Flickr, Chicago Bicycle Program (bottom)

Fully protected intersections, such as those proposed for Shoreline Boulevard, are relatively new to American cities and do present some unique implementation challenges. These include:

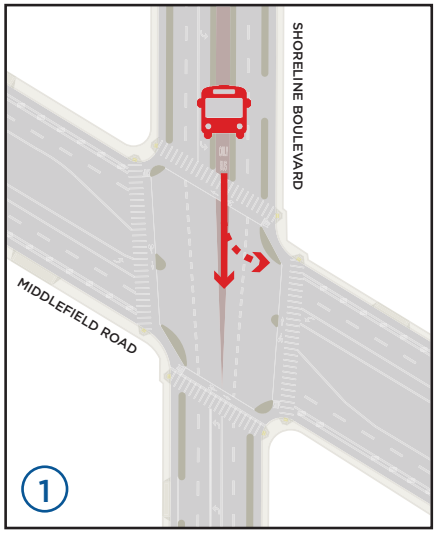
- Impacts to traffic, particularly due to the prohibition of right turns on red. The traffic impacts for Shoreline Boulevard are described in more detail below.
- Right turns for trucks with the refuge islands: Truck turns were evaluated for Shoreline Boulevard and remain feasible given the substantial width at each approach of the intersections and the size of the receiving lanes on Shoreline Boulevard and its cross streets.
- FHWA approval for leading bicycle signal phasing: While bicycle signals have received approval from FHWA, signal phasing plans with leading bicycle intervals are not currently compliant with MUTCD and would need to proceed through FHWA's designated experimentation process.

Driveways

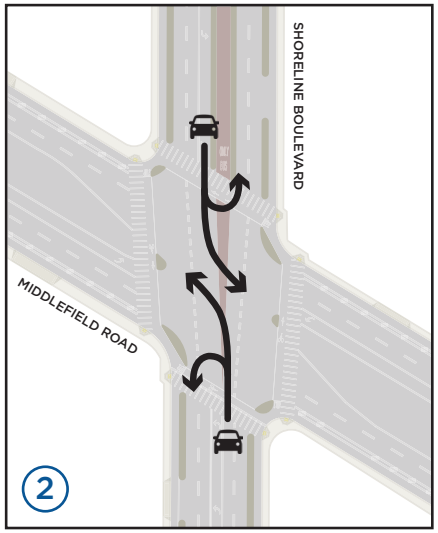
A key design challenge for protected bicycle lanes is the conflict point with motorists at driveways. Of particular concern is a right turn by vehicles into or out of a driveway across the protected bicycle lane. On Shoreline Boulevard, there are a large number of driveways that cannot be closed because vehicle access must be maintained. The challenge of driveways with protected bicycle lanes has been successfully mitigated in other cities and there are a number of best practices to apply. Driveways must be made highly visible with visual cues so that both bicyclists and motorists can be prepared to stop. Some best practices are listed below and examples of such treatments are shown.

- Maintain a clear sight triangle of 10-20 feet on all approaches to the driveway
- Provide advance stop lines for motorists exiting driveways
- Raise the protected lane and adjacent sidewalk at the driveway and utilize a sharper slope to create a speed bump effect
- Channelize vehicles with tight turning radii to slow down turns
- Provide high-visibility signage and pavement markings at driveways to give priority to bicyclists

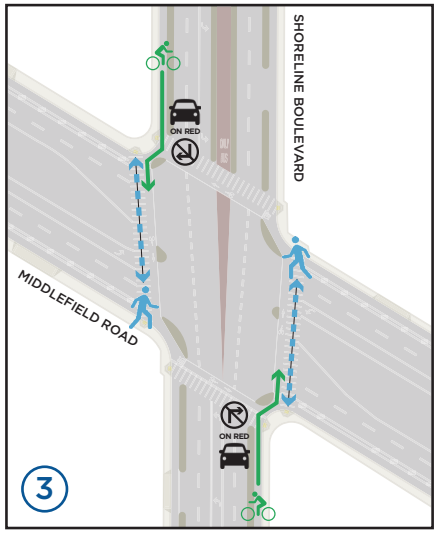
FIGURE 4-3 EXAMPLE SIGNAL PHASING AT PROTECTED INTERSECTION (MIDDLEFIELD ROAD)



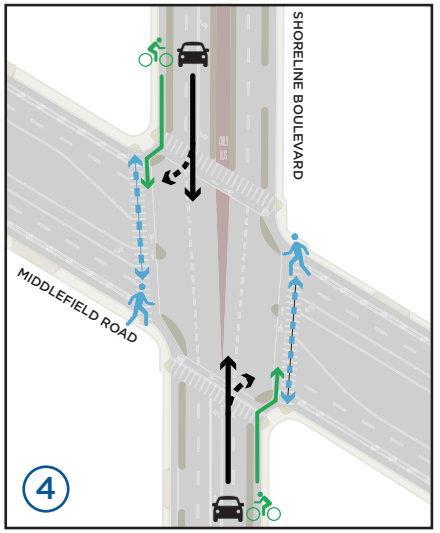
TRANSIT ONLY
QUEUE JUMP
(PM ONLY)



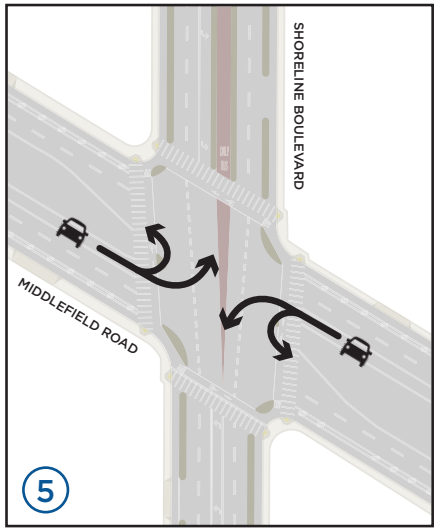
SHORELINE BLVD
LEFT TURN/U-TURN



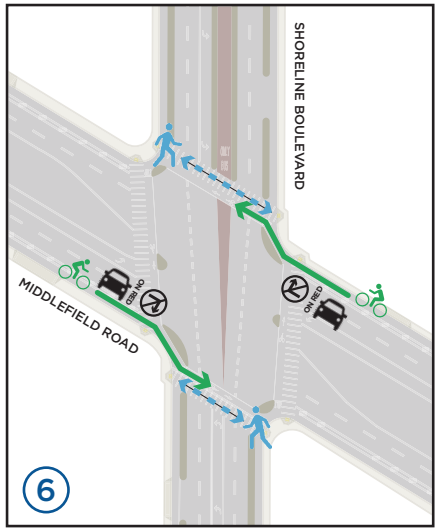
SHORELINE BLVD
BIKE/PED
LEADING INTERVAL



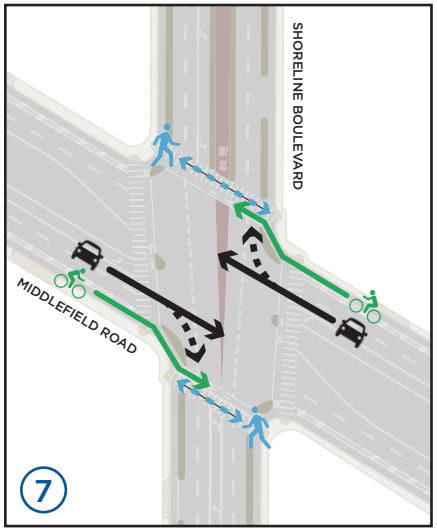
SHORELINE BLVD
THROUGH & RIGHT-
TURN *(Yield to bikes)*



MIDDLEFIELD RD
LEFT TURN/U-TURN



MIDDLEFIELD RD
BIKE/PED LEADING
INTERVAL *(Yield to bikes)*



MIDDLEFIELD RD
THROUGH &
RIGHT TURN

Maintenance

Another challenge of protected bicycle lanes is maintenance, which is important for bicycle safety. Cracked or uneven pavement or debris in the lane can create a significant safety hazard for bicyclists. Protected lanes typically have a higher maintenance burden than conventional bicycle lanes because the raised barriers often funnel debris into the lane, and prevent the natural sweeping effect of passing vehicles. Furthermore, standard street sweeping vehicles typically need 8.5-10 clear feet and will not fit into protected bicycle lanes. Many cities that have implemented protected lanes, such as Portland and Seattle, have purchased specialized street sweeping equipment specifically designed to fit within protected lanes. These vehicles cost approximately $225,000.

To ensure proper maintenance of the protected lanes, it is recommended that the City purchase a specialized street sweeper and develop a regular and consistent maintenance plan. With the proposed installation of new trees along Shoreline Boulevard, additional sweeping will likely be needed along this corridor, especially during the fall season.

Consistent maintenance of protected bicycle lanes is needed to remove hazardous debris.
Image from Flickr, PeopleForBikes

Travel Lane Width

One of the primary goals for this study is to make the Shoreline Boulevard corridor more accessible and accommodating for all roadway users. Along Shoreline Boulevard, the posted speed limit is 35 miles per hour, but the roadway is designed for much higher speeds and local residents consistently report that vehicles typically travel in excess of the speed limit.

Vehicle speed is directly related to the cause and severity of crashes. For a vehicle travelling 20-25 miles per hour, the pedestrian fatality risk in a collision is 5%. The pedestrian fatality risk in a collision with a vehicle travelling 40 miles per hour or more jumps to 85%.[19] The relationship between vehicle speed and crash risk is illustrated in Figure 4-4.

Many guidelines, including the AASHTO Green Book, recommend 12-foot lanes on major arterials, advocating that wider lanes are safer for vehicles and ensure adequate roadway capacity. However, research has shown that narrower lanes are correlated with lower vehicle speeds[20] and lower crash rates, and roadway capacity is not necessarily impacted by reduction in travel lane width.[21]

Therefore, to reduce speeds and increase roadway safety for all users, it is proposed that vehicle travel lanes be narrowed throughout Shoreline Boulevard to between 10-11 feet, depending on the location. Travel lanes on Stierlin Road will be narrowed to 10 feet.

FIGURE 4-4 RELATIONSHIP OF VEHICLE SPEED TO CRASH RISK

Vehicle Speed	Stopping Distance (ft.)*	Crash Risk	Fatality Risk
10-15 mph	25	5%	2%
20-25 mph	40	15%	5%
30-35 mph	75	55%	45%
40+ mph	118	90%	85%

*Includes perception, reaction, and braking times.

Adapted from NACTO Urban Street Design Guide

Source: Traditional Neighborhood Development: Street Design Guidelines (1999), ITE Transportation Planning Council Committee 5P-8

19 http://nacto.org/usdg/design-speed/

20 http://nacto.org/usdg/lane-width

21 http://nacto.org/docs/usdg/lane_widths_on_safety_and_capacity_petritsch.pdf

While improving transit, bicycle, and pedestrian travel is a primary focus of this study, it is also recognized that this particular section of Shoreline Boulevard plays an important role in moving vehicles in and out of North Bayshore and the downtown area. The City determined early on in the study that removal of a travel lane on Shoreline Boulevard to accommodate transit or bicycle infrastructure was not feasible.

Therefore, in order to install a new transit lane, protected bicycle lanes, and improve the pedestrian realm ***without removing a travel lane***, the right-of-way on Shoreline Boulevard must be expanded. The estimated right-of-way impacts to the corridor are summarized in Figure 4-5. Because the existing right-of-way varies and desired improvements change throughout the corridor, the need for additional right-of-way also varies throughout the corridor. For example, the right-of-way impacts are more significant north of Middlefield Road because this section includes both the proposed transit and protected bicycle lanes. South of Middlefield Road, no transit lane is proposed and the impacts are more limited. Right-of-way at certain intersections is also significantly impacted due to the proposed median and curbside transit stops.

When evaluating the estimated impacts, it is important to emphasize that the proposed package of improvements represent the **ideal** design, incorporating as robust a package of improvements for the transit lane, bicycle lanes, and pedestrian realm as possible. As the project enters the next phase of detailed design, engineering, and environmental clearance, the proposed design may be modified to minimize the right-of-way impacts. For example, the following changes could be made:

- Reduce the 5-foot transit lane buffers in certain locations (maintain minimum of two feet)
- Reduce the 6-foot bicycle lane buffers in certain locations (maintain minimum of three feet)
- Reduce the transit lane width in certain locations (maintain minimum of 12 feet)
- Reduce travel lanes (maintain minimum of 10 feet)
- Reduce the width of sidewalk in certain locations (maintain minimum of five feet)
- Shift segments or the entire roadway to the east or west in certain locations

Making changes to the preferred design will result in various tradeoffs. Reducing the size of the buffers would prevent the installation of canopy trees at those locations and impact the type of landscaping that could be installed, limiting aesthetic improvements. Reducing the bicycle lane buffers could negatively impact bicyclist safety and comfort. Reducing the sidewalk width could impact pedestrian flow and comfort. Shifting the roadway would increase implementation costs and also require long transition zones to facilitate safe and gradual changes.

- The proposed design will undoubtedly require additional right-of-way, but no specific parcels or changes have been identified at this time. In reality, right-of-way changes will need to be resolved

FIGURE 4-5 ESTIMATED RIGHT-OF-WAY IMPACTS*

Street	From	To	Potential ROW Needed	
			West Side	East Side
Stierlin Road	Washington Street (limit)	Wright Street	0′ to 6′	0′
Stierlin Road	Wright Street	Stierlin Road Slip Lane	0′ to 6′	0′ to 3′
Stierlin Road Slip Lane	Stierlin Road	Shoreline Boulevard	0′	0′
Shoreline Boulevard	Montecito Avenue	New Safeway xing	0′ to 4′	7′
Shoreline Boulevard	New Safeway xing	Middlefield Road	1′ to 7′	0′ to 4′
Shoreline Boulevard	Middlefield Road	Terra Bella Avenue	12′ to 17′	8′ to 15′
Shoreline Boulevard	Terra Bella Avenue	U.S. Route 101 Ramp South	15′ to 17′	0′ to 18′
Shoreline Boulevard (Bridge)	U.S. Route 101 Ramp South	La Avenida Street	26′	0′
Shoreline Boulevard	La Avenida Street	Pear Avenue	4′ to 35′	0′ to 17′
Shoreline Boulevard	Pear Avenue	Plymouth Street (Existing)	16′ to 21′	4′ to 23′
Shoreline Boulevard	Plymouth Street (Existing)	Space Park Way (limit)	17′	15′

***** Represents the minimum and maximum additional required right-of-way by segment.

on a parcel-by-parcel basis with in-depth discussions between the City and property owners (the City has already met with many property owners to discuss these right-of-way issues). The City will continue to work to minimize the impacts to the greatest degree possible, and further acknowledges that any right-of-way acquisition would happen only if property owners are adequately compensated.

The degree and type of right-of-way impacts vary along Shoreline Boulevard.

Traffic Impacts

A preliminary traffic analysis of the proposed improvements was conducted as part of this study. The analysis included all of the proposed changes to the street network, including provision of the transit lane, protected bicycle lanes, and signal phasing changes. Project impacts were evaluated following the guidelines of the City of Mountain View.

A more detailed traffic analysis will be required as part of the next phase of detailed design, engineering, and environmental analysis. Level of service (LOS) will remain a key metric for this analysis and an ongoing planning tool for the City, but it should be noted that California is currently revising how traffic impacts will be evaluated as part of the California Environmental Quality Act (CEQA). Per SB 743, degradations in LOS can no longer constitute a "significant impact" under CEQA in certain locations. New criteria to measure transportation impacts are currently being finalized, but new CEQA metrics will likely focus on a shift from strictly measuring vehicle delay to a more holistic assessment of a project's impacts on greenhouse gas emissions and vehicle miles traveled.

The operations of roadway facilities are typically described with LOS classifications, a quantitative description of traffic flow based on factors such as speed, travel time, delay, and freedom to maneuver. Synchro software was also used to evaluate the coordinated intersections on Shoreline Boulevard. Detailed signal timings were coded into the Synchro software and the arterial LOS calculations were performed using the 2000 HCM method. The Synchro software program was also used to report average travel speeds for the Shoreline Boulevard corridor between signalized intersections.

FIGURE 4-6 INTERSECTION LOS AND DELAY COMPARISON

Intersection	Peak Period	Existing Lane Geometry + Existing Volumes		Proposed Lane Geometry + Existing Volumes		% Change
		Delay	LOS	Delay	LOS	
Shoreline Boulevard/Montecito Avenue/Stierlin Road	A.M.	23	C	30.6	C	33%
	P.M.	29.4	C	32.2	C	10%
Shoreline Boulevard/Middlefield Road	A.M.	83.8	F	89.7	F	7%
	P.M.	71.2	E	90.9	F	28%
Shoreline Boulevard/Terra Bella Avenue	A.M.	16.7	B	17.9	B	7%
	P.M.	16.4	B	16.8	B	2%
Shoreline Boulevard/U.S. Route 101 SB Off Ramp	A.M.	12	B	7.8	A	-35%
	P.M.	14.6	B	8.1	A	-45%
Shoreline Boulevard/U.S. Route 101 NB Off Ramp	A.M.	125.7	F	75.2	E	-40%
	P.M.	32	C	36.1	D	13%
Shoreline Boulevard/Pear Avenue	A.M.	37.7	D	56.8	E	51%
	P.M.	28.4	C	40.5	D	43%
Shoreline Boulevard/Charleston Road	A.M.	26.5	C	26.5	C	0%
	P.M.	102.7	F	104.5	F	2%

Figure 4-6 summarizes the estimated traffic impacts at each of the six study intersections along the Shoreline Boulevard corridor under two scenarios during the morning peak-hour (between 7:00 to 9:00 a.m.) and evening peak-hour (4:00 to 6:00 p.m.). In addition, Figure 4-7 summarizes the LOS for the three options for a new dedicated crossing on Shoreline Boulevard between Stierlin Road/Montecito Avenue and Middlefield Road. The "Existing Lane Geometry + Existing Volumes" scenario is based on existing roadway conditions, traffic controls, lane geometry, and traffic counts collected as

FIGURE 4-7 INTERSECTION LOS AT DEDICATED PEDESTRIAN CROSSING

Option	Intersection	Peak Period	Proposed Lane Geometry + Existing Volumes	
			Delay	LOS
1	Shoreline Boulevard/Bailey Park-Buddhist Temple Driveway (Signalized Intersection)	A.M.	9.0	B
		P.M.	15.2	B
2	Shoreline Boulevard/Bailey Park-Buddhist Temple (Actuated Crosswalk)	A.M.	6.7	A
		P.M.	6.8	A
3	Shoreline Boulevard/Mountain Shadows Drive	A.M.	15.0	B
		P.M.	22.0	B

part of the Shoreline Boulevard MTC PASS Project. The "Proposed Lane Geometry + Existing Volumes" includes the proposed improvements as part of the Shoreline Boulevard Corridor Study.

Future year scenarios were also assessed at a conceptual level, but not included at this time due to the need for additional clarity about the specific development plans along Shoreline Boulevard and the implementation of specific transportation demand management measures for the North Bayshore area.

Key findings include:

- Under the "Proposed Lane Geometry + Existing Volumes" scenario, average delay at most of the study intersections is projected to increase with the implementation of the proposed improvements.
- The estimated impacts are limited as most intersections are projected to continue to operate at the same LOS.
- The biggest increases in vehicle delay are projected at Shoreline Boulevard/Pear Avenue in both peak periods, Shoreline Boulevard/Montecito Avenue/Stierlin Road in the morning peak period, and Shoreline Boulevard/Middlefield Road in the evening peak period.
- Vehicle delay is expected to be reduced at the U.S. Route 101 ramps, notably at the southbound ramp where the left turn pocket to State Route 85 would be eliminated.
- The proposed scramble phase at Terra Bella Avenue is projected to have minimal impacts on vehicle delay.
- Any new dedicated pedestrian crossing along Shoreline Boulevard would operate with minimal delay for vehicles.

Tree Impacts and Landscaping

Inherent in the discussion of right-of-way impacts is the need to assess impacts to the existing trees along Shoreline Boulevard. In order to install the center-running transit lane, the existing median and its trees must be replaced. The median tree loss will occur in the area between Terra Bella Avenue and Space Park Way. Based on a preliminary assessment, it is believed that these trees are relatively young (less than 20 years old or a trunk circumference of 48") and their removal would likely not be subject to City Heritage Tree Ordinance requirements[22].

However, it is very likely that there are heritage trees, including key species such as Quercus (oak), Sequoia (redwood) or Cedrus (cedar), in the adjacent right-of-way along the Shoreline Boulevard corridor. An additional inventory and study of trees by an arborist is underway. In general, the City will work to modify the design to preserve identified heritage trees.

Similar to mitigating the right-of-way impacts, several changes could be made to the design to preserve a specific tree or set of trees. Figure 4-9 illustrates some potential design refinements.

- Reduce the 5-foot transit lane buffers in certain locations (minimum of two feet)
- Reduce the 6-foot bicycle lane buffers in certain locations (minimum of three feet)
- Reduce the transit lane width in certain locations (minimum of 12 feet)
- Reduce travel lanes (minimum of 10 feet)

22 http://www.mountainview.gov/depts/cs/parks/heritagetree/default.asp

- Reduce the width of sidewalk in certain locations (minimum of five feet)
- Shift segments or the entire roadway to the east or west in certain locations
- Realign sidewalks and/or protected bicycle lanes around heritage trees

The preferred and ideal design includes design concepts to mitigate and replace the tree loss, enhance aesthetics and comfort within the corridor, and further reduce vehicle speeds with landscaping that visually narrows the corridor. Specifically, the buffers for the transit lane and the protected lane are five and six feet, respectively. This width provides a minimum amount of space to plant new trees and offset tree loss. Significant changes to the design to accommodate existing heritage trees or landscaping, notably the buffer width, would impact the ability to replace lost trees or expand the tree canopy.

Figure 4-8 summarizes the estimated tree loss and potential number of trees that could be replaced based on the preferred design. Tree replacement estimates are conceptual in nature, highly dependent on underground utilities, and would be refined based on the final design. In general, the installation of trees should follow simple guidelines and best practices, including:

- Tree spacing on sidewalk/buffers: 20-25 feet on center (assuming medium size tree – 20-35-foot crown diameter)
- Trees located in the median buffers should have a vertical clearance of the lowest branch of 8 feet in height over the median, and 15.5 feet in height for any portion of the tree that overhangs the roadway
- No trees within 10 feet of intersections/driveways on approach (sidewalk buffer and median buffer). 14-foot minimum height of lowest branch within 25 feet of intersection
- No trees within "short" buffer sections (i.e. near driveways) and install only low landscaping
- Ideally, species should provide adequate canopy, be drought-resistant, and account for root structure to minimize long-term impacts to the roadway, sidewalks, utilities, and proposed buffers. Selection of tree species would ultimately be determined based on existing City guidelines.[23]

23 http://www.mountainview.gov/depts/comdev/planning/regulations/zoning/trees.asp

Additional study of tree impacts and mitigations will be required.

FIGURE 4-8 ESTIMATED TREE IMPACTS AND POTENTIAL REPLACEMENT

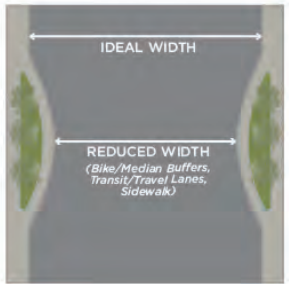
Segment		Estimated Tree Impacts		Potential Tree Replacement	
From	To	Median	Adjacent ROW (Public/Private)	Bicycle Buffer	Transit Buffer
Stierlin Road / Montecito Avenue	Middlefield Road	None	TBD	93	6
Middlefield Road	Terra Bella Avenue	None	TBD	33	49
Terra Bella Avenue	Plymouth Street	80	TBD	21	86
			TOTAL	**147**	**141**

FIGURE 4-9 CONCEPTUAL MITIGATIONS FOR TREE IMPACTS

PREFERRED DESIGN FOR SHORELINE BOULEVARD

OPTION 1: REDUCE AND RE-ROUTE BICYCLE BUFFERS/SIDEWALK NEAR TREES

OPTION 2: REDUCE ALL BUFFERS AND TRAVEL LANES FOR KEY SEGMENT



- In addition, the proposed buffers for the transit and protected bicycle lanes offer substantial new space to add landscaping and incorporate stormwater management techniques to improve drainage and minimize runoff. A combination of the following elements could be installed.
  - Permeable paving to reduce stormwater runoff and improve water quality
  - Bioretention facilities to collect and filter runoff, as well as improve aesthetics
  - Bioswales to collect and convey runoff
  - Green gutters to capture and slow runoff
  - Vegetated buffers to collect runoff from adjacent impervious surfaces
  - Drought-resistant landscaping (not exceed 3.5 feet above the roadway)
  - Removable planters, which can reduce maintenance burden
  - Integrated drip system for watering
  - Integrated drainage system to ensure no standing water on roadway or within protected bicycle lanes
  - All cross bars over inlets within protected bicycle lanes should be "bicycle safe" to prevent slippage or stuck wheels – perpendicular to traffic flow and adequately weight bearing

The bicycle lane buffer and pedestrian realm can include stormwater management features to reduce runoff and improve aesthetics.

Images from Flickr, Dan Reed (top); Flickr, Gordon Werner (bottom)

Pavement Markings and Signage

A key component of a successful bicycle or pedestrian facility is proper markings and signage. These elements are crucial because they regulate the roadway environment and interaction of modes, ensure that facilities are highly visible, provide adequate warning, and offer wayfinding guidance. These elements should be clearly visible, intuitive, and account for movements of all users.

In general, the California Manual on Uniform Traffic Control Devices (MUTCD)[24] standards should be followed for development and installation of markings and signage. The NACTO Urban Bikeway Design Guide also provides extensive guidelines and offers best practices for emerging facility types, such as protected bicycle lanes, bicycle signalization, and intersection treatments. Basic principles include:

- Utilize the color green for bicycle lane pavement markings and the color red for transit lane pavement markings.
- To minimize installation and maintenance costs, apply color treatments only in the conflict areas for the protected bicycle lanes (driveways, intersections, and merge zones).
- Apply color treatments consistently throughout the corridor.
- Utilize skid resistant and reflective materials for pavement markings. A number of materials have been used for pavement marking, but thermoplastic is emerging as the industry's preferred material. Thus far, it has proved to be the most visible, durable, and has the lowest maintenance costs. However, thermoplastic has the highest upfront costs.[25]
- Develop a consistent and intuitive wayfinding program with signage placed at appropriate locations
- Place "decision" signage in advance of all turns and include destinations, directions, and distance
- At intersections:
  - Crossing marking should match width and position of leading bike lane
  - Utilize a combination of dotted extensions, shared lane markings, colored pavement, or elephant tracks to mark the bicycle crossing through the intersection
  - Develop a consistent maintenance plan to ensure that markings and signage remain highly visible

A coordinated wayfinding program and high-visibility treatments at conflict points are key components of protected bicycle lane.

Image from Flickr_Paul Krueger

24 http://www.dot.ca.gov/hq/traffops/engineering/mutcd/index.htm

25 Approximately $3-6 per square foot for raw materials and $10-14 per square foot installation

Lighting

Street lighting serves a crucial function in defining and organizing the streetscape at night. Quality lighting improves safety for vehicles, bicyclists, and pedestrians. Pedestrian-scale lighting is also crucial to fostering a strong sense of place and increasing the attractiveness of the street. Lighting is important to economic vitality and quality of life.

Existing lighting in the Shoreline Boulevard and Stierlin Road corridors is predominantly provided with street light "cobrahead" fixtures (20-30 feet in height). These lights are designed to primarily illuminate the roadway for motorists. They are ineffective at lighting adjacent sidewalks due to their height and wide spacing. As a result, the corridors are poorly lit at night, creating a deterrent for those traveling by foot or by bike.

As part of the proposed plans it is recommended that significant lighting improvements be made throughout the corridor. Outlined below are some principles and guidelines to facilitate such improvements.

- Locate street lights close to the curb and out of the sidewalk through zone
- Utilize pedestrian-scale fixtures, such as shorter post-top ("acorn") type lights (typically 12-15 feet in height)
- Coordinate lighting with other streetscape fixtures
- Install pedestrian-scale lighting on existing street lights to minimize sidewalk clutter
- Locate street lights so that the tree canopy does not block the illumination
- Utilize fixtures that minimize sky glow and leakage to reduce impacts to surrounding uses
- Establish adequate spacing standards to ensure proper and even distribution of light
- Convert older orange-colored, high-pressure sodium (HPS) lamps and fixtures to more sustainable and higher quality white light-emitting diode (LED) fixtures
- Install new LED fixtures as feasible

Pedestrian-scale lighting can improve safety and foster a sense of place.

STIERLIN ROAD + STIERLIN ROAD/MONTECITO AVENUE/SHORELINE BOULEVARD

Proposed Improvements

Under the preferred alternative, the Stierlin Road/Montecito Avenue/Shoreline Boulevard intersection would be transformed to improve safety, access, and convenience for bicyclists and pedestrians. Similar to Middlefield Road, this intersection would offer "protected" treatments for bicyclists and pedestrians while significantly slowing down vehicles and their turning movements. The reconfigured intersection would facilitate the connection for southbound bicyclists from the one-way protected bicycle lane on Shoreline Boulevard[26] to Stierlin Road by way of a two-stage turn. Similar turns from Stierlin Road or Montecito Avenue to Shoreline Boulevard would also become safer. As with Middlefield Road, bicyclists and pedestrians would get their own signal phase and motorists would be prohibited from turning right on a red light.

The Stierlin Road slip lane would also be reconfigured to provide northbound bicyclists a connection from Stierlin Road to Shoreline Boulevard via a one-way protected bicycle lane. The bicycle lane would be 6.5 feet wide with an adjacent 2.5-foot raised buffer. Access to the Buddhist Temple from the slip lane would still be available from an 11-foot travel lane, which would be realigned at the southern end to facilitate vehicles crossing over the westbound bicycle lane. The existing driveway to the Temple, as well as utility access to the Hetch Hetchy right-of-way would be maintained. Access for emergency vehicles and light trucks would not be impacted by the changes.

Further south, Class II bicycle lanes would be implemented on Stierlin Road, offering a direct connection between Shoreline Boulevard and the Transit Center/Downtown. The lanes would be six feet in width and would require the removal of existing on-street parking on the east side of Stierlin Road in order to accommodate the lanes within the existing right-of-way.

Traffic calming elements would also be installed on Stierlin Road to reduce vehicle speeds and improve safety for bicyclists and pedestrians. These elements include:

- Reducing the posted speed limit to 25 miles per hour from 30 miles per hour
- Reducing travel lane widths to 10 feet
- Installing a raised intersection at Fountain Park Lane
- Installing bulb outs and high-visibility crosswalks at all intersections
- Installing pedestrian-scale lighting
- Providing sharrow markings and speed tables on Central Avenue to facilitate and enhance the connection to Moffett Boulevard
- Transitioning to the Central Expressway/Moffett Boulevard/Castro Street intersection via the bicycle and pedestrian paseo to be built as part of the 100 Moffett Boulevard development[27]

Other design features in this segment include:

- Eliminating one lane on southbound Stierlin Road, just east of Shoreline Boulevard
- Better aligning Stierlin Road and Montecito Avenue vehicle lanes across Shoreline Boulevard
- Providing a buffered bike lane on the north and south Stierlin Road approaches to Shoreline Boulevard
- Utilizing high-visibility driveway treatments to mitigate conflicts between bicyclists and right-turning motorists right-turning vehicles
- Realigning the northbound vehicle transition to the Stierlin Road slip lane to require a right turn movement. This change is necessary to mitigate conflicts with vehicles proceeding to the slip lane and bicyclists continuing west to Shoreline Boulevard or Montecito Avenue.

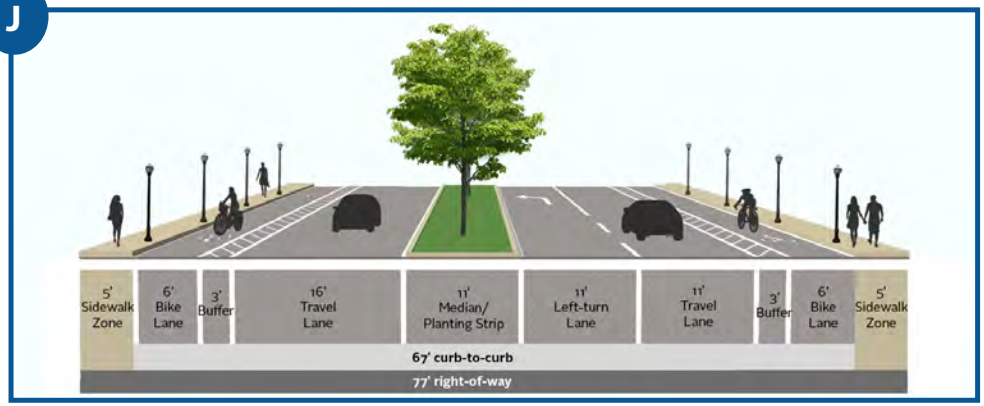
Access to the Buddhist Temple from the slip lane would still be available by way of an 11-foot travel lane, realigned to facilitate vehicles crossing over the westbound bicycle lane.

26 The one-way separated bicycle lanes are shown to continue south on Shoreline, but the final plans for this segment will be confirmed as part of a separate study (discussed above)

27 Closure of vehicle access from Steirlin to Central Expressway was approved as part of the 100 Moffett development

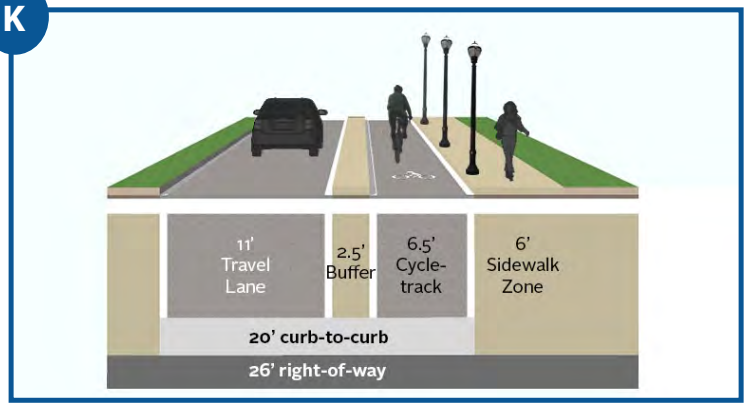
Stierlin Road + Stierlin Road/Montecito Avenue/Shoreline Boulevard

J



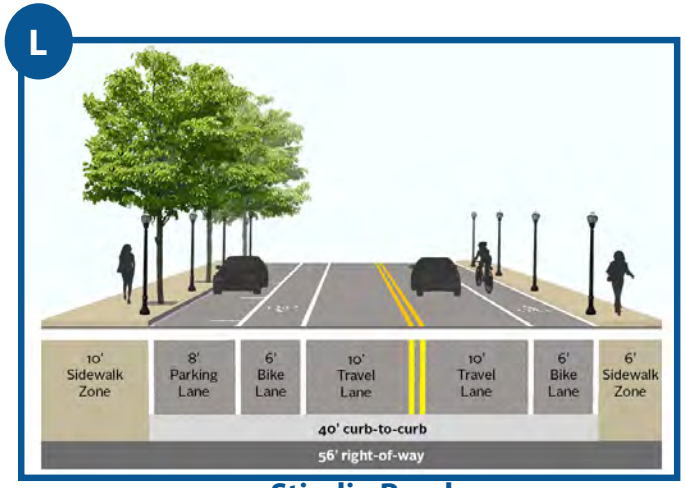
Stierlin Road at Shoreline Boulevard

K



Stierlin Road Slip Lane

Stierlin Road + Stierlin Road/Montecito Avenue/Shoreline Boulevard (cont.)



Stierlin Road

Parking Impacts

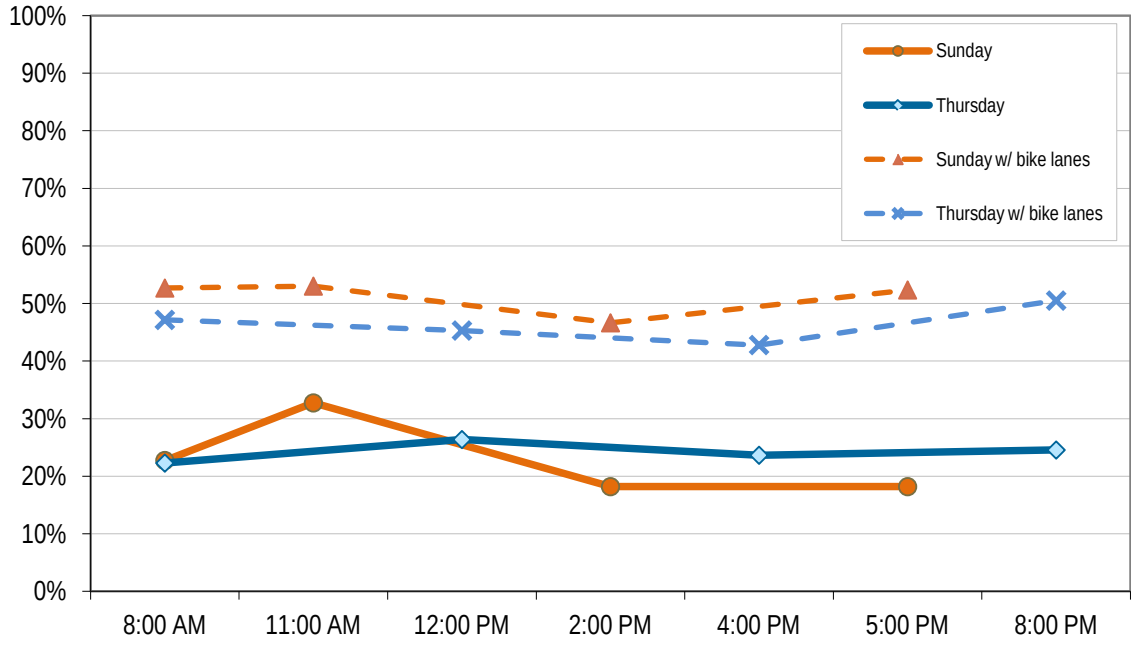
The proposed bicycle lanes on Stierlin Road would require the removal of on-street parking on the east side of the street. This parking removal is necessary to provide adequate room for the bicycle lanes while maintaining the existing curb-to-curb right-of-way. To better understand the impacts to the neighborhood, a parking study was done to inventory the number of spaces and assess existing parking occupancy rates. Parking counts were conducted on two Thursdays and two Sundays in summer and fall of 2014 in order to provide as wide a range of parking conditions as possible and capture parking activity during a typical or average weekday and weekend. Key findings from the study (illustrated in Figure 4-10) include:

- A total of 881 parking spaces were counted in the study area, 365 of which are located on-street. The remaining 516 counted spaces are located in the various off-street lots included in the study.[28]
- Stierlin Road has approximately 110 on-street spaces, 47 on the west side and 63 on the east side.[29] Approximately 21 spaces on the east side of Stierlin Road are already approved to be removed as part of the 100 Moffett Boulevard development. All of the remaining spaces on the east side would be removed to install the proposed bicycle lanes.

28 All on-street spaces along public rights of way were included in the study. Only a select number of off-street facilities were counted (Stierlin Square Apartments, Stierlin Arms Apartments, Buddhist Temple, Wonder Years Preschool, IFES Society, and Community Services Agency), and private residential driveways or garages were not included in the study.

29 Along on-street blocks in the study area, the on-street inventory was not clearly delineated by striping. In these cases, surveyors made educated assumptions of inventory based on a common size for an on-street parking space, typically 20 feet, or observed utilization.

FIGURE 4-10 STIERLIN ROAD PARKING OCCUPANCY



- Peak occupancy of Stierlin Road's on-street spaces on Thursday was 26% and on Sunday was 33%. At peak demand, 16 vehicles were parked on the east side of Stierlin Road.
- Peak occupancy for the entire study area for both on- and off-street spaces on Thursday was 33% and on Sunday was 41%.
- Based on the observed parking conditions, there is enough parking to accommodate demand in the neighborhood, even with removal of parking on the east side of Stierlin Road. Parking on the west side of Stierlin Road, as well as on adjacent blocks and in off-street lots, is underutilized and would very likely be able to accommodate the displacement of vehicles from the east side of Stierlin Road.

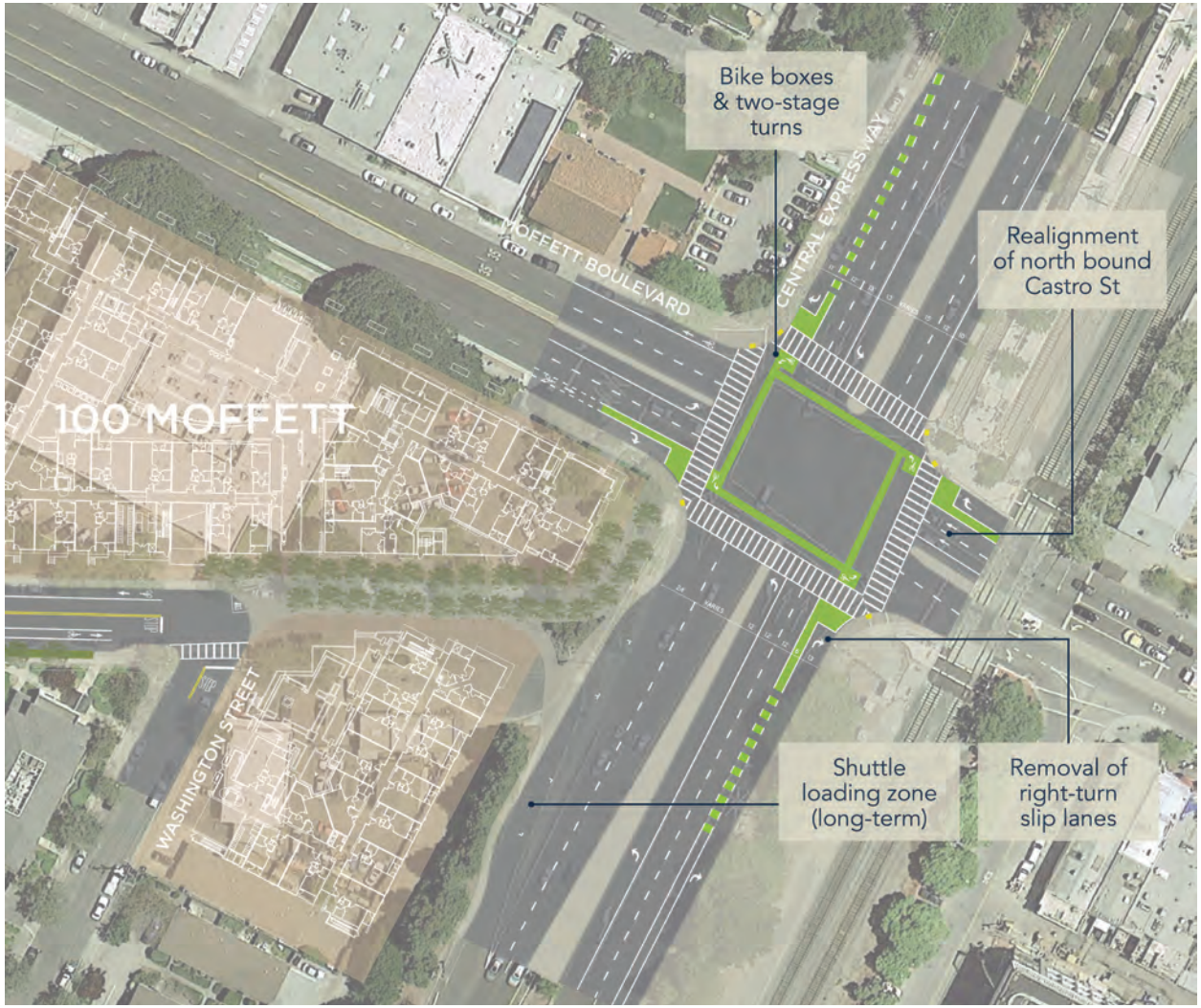
CENTRAL EXPRESSWAY/MOFFETT BOULEVARD/CASTRO STREET

Proposed Improvements

As discussed in Chapter 3, the intersection of Central Expressway/Moffett Boulevard/Castro Street poses a significant barrier to travel in the corridor. The complexity of the movements at the intersection, high vehicle volumes, and need for signal phasing that must safely accommodate the passage of Caltrain trains are all factors that contribute to a congested environment which provides only limited accommodation for bicyclists and pedestrians. It is already a heavily utilized intersection, accommodating roughly 400 pedestrian and bicyclist crossings in the peak hour, the highest number in the County's expressway system. It is also a unique intersection in that it serves as the northern gateway into Mountain View's downtown and commercial core.

Furthermore, the increasing transit and shuttle activity at the Transit Center, new mixed use and transit-oriented land uses near the station, and plans for high-quality bicycle infrastructure in the corridor all highlight the need for a comprehensive long-term vision for this area. Recognizing these challenges, this study proposes a series of short-term recommendations designed to make targeted, low-cost improvements to the intersection. A planning strategy to address long-term issues is further described in Chapter 5.

The proposed short-term improvements for Central Expressway/Moffett Boulevard/Castro Street are described and illustrated in detail on the following page.



Reconfigure Northbound Castro Street

It is proposed that northbound Castro Street, between the train tracks and Central Expressway, be reconfigured to eliminate the left-turn lanes onto westbound Central Expressway. The new alignment would allow for two through lanes, a bicycle lane, and a designated right turn lane onto eastbound Central Expressway.
The existing lanes would likely need to be shifted to ensure proper alignment with the receiving lanes on northbound Moffett Boulevard. Motorists would still be able to access westbound Central Expressway from Castro Street by traveling to Shoreline Boulevard via other (e.g., California Street, Villa Street) local east-west streets. This reconfiguration would provide the following benefits:

- Allow the signal phasing to be adjusted to add additional crossing time for pedestrians on the western leg of the intersection. The signal time previously dedicated to the left-turn movements from Castro Street would be reallocated to instead allow pedestrians to cross both the through clearing phase and the phase for left-turns from southbound Moffett Boulevard onto eastbound Central Expressway.
- Provide more time to quickly clear vehicles off tracks during the approach of Caltrain trains.
- Enable the creation of a designated bike lane on this portion of Castro Street with a separate lane for right-turning vehicles to reduce conflicts between motorists and bicyclists.

The existing configuration of Castro Street at Central Expressway creates challenges related to clearing of the Caltrain tracks and crossing time for pedestrians.

Closure of Right-turn Slip Lanes

Right turns would still be allowed on all approaches of the intersection, but the existing slip lanes on Central Expressway would be removed. The intersection corners would be extended and additional pedestrian space would be provided. A right-turn pocket would also be provided and lengthened to allow for adequate vehicle storage and ensure that through movements are not significantly impacted. By eliminating the right-turn slip lanes, vehicle turning speeds will be reduced and pedestrians will no longer have to cross the slip lanes in addition to crossing Central Expressway. During peak periods, pedestrians must often stand in the roadway or slip lane because there is not enough refuge area in the current configuration. The high volumes of pedestrians would be more safely accommodated with the additional pedestrian space at the corners.

Removing the right-turn slip lanes would reduce vehicle turning speeds and provide additional pedestrian refuge space.

Signal Phasing

Closing the left turn lanes on northbound Castro Street would facilitate additional pedestrian crossing time on the west side and be a significant improvement. However, observations reveal that the natural desire line to/from the Transit Center is on the eastern leg of the intersection. While adding a pedestrian phase to the west side would help, many crossings will still occur on the east side because it is closest to the station. Furthermore, during peak periods when there is a high volume of trains, pedestrians and bicyclists can wait up to five minutes to cross Central Expressway. Many pedestrians will choose not to wait that long and instead still cross against the signal. This is a challenging condition that increases the potential for collisions.

It is recommended that the City continue to work with the County to evaluate how more crossing time can be allocated to pedestrians and bicyclists at Central Expressway. The complexity of the signal timing and the need to preempt the crossings for the trains makes adjustments to the timing difficult. Nevertheless, the allocation of additional crossing time on Central Expressway is a concept worthy of additional study.

High-visibility Crosswalks

It is recommended that high-visibility crosswalks (also known as ladder, zebra, and continental crosswalks) be installed on all legs of the intersection. The primary goal of this improvement is to increase the visibility of pedestrians and provide a clearly defined space in which pedestrians can cross and where motorists can expect pedestrians to be. As recommended by NACTO: "High-visibility crosswalk markings are preferable to standard parallel or dashed pavement markings. These are more visible to approaching vehicles and have been shown to improve yielding behavior."[30]

In order to accommodate the bike boxes and two-stage turn boxes, the crosswalks would need to be moved back from the intersection by approximately 8-16 feet.

30 http://nacto.org/usdg/intersection-design-elements/crosswalks-and-crossings/conventional-crosswalks/

Pedestrians consistently cross Central Expressway against the light. Adjusting the signal phasing could help to reduce this behavior.

It is recommended that a coordinated package of bicycle pavement markings and signage be installed to improve the visibility and positioning of bicyclists, and facilitate left turns through the intersection. These markings include:

Bicycle Boxes: During a red light, bicyclists will typically split the lane to get in front of waiting vehicles. At high-volume and congested areas, such as Castro Street/Moffett Boulevard/Central Expressway, this can result in bicyclists encroaching into crosswalks and forcing pedestrians into the intersection. A bicycle box formalizes and regulates this behavior by providing a designated area at the head of a traffic lane where bicyclists can get ahead of the queue at a red light.[31] Bicycle boxes also allow bicyclists to group at the front and then clear an intersection more quickly. Research has shown that bicycle boxes reduce encroachment into the crosswalk by bicyclists and motorists, reduce conflicts with right-turning vehicles, improve yielding to bicyclists by motorists, and are a preferred treatment by both bicyclists and motorists.[32]

Detailed design guidance for bicycle boxes can be found in the NACTO *Urban Bikeway Design Guide*, but generally includes the following elements:

- Boxes should be 10-16 feet deep, with a deeper box in high-volume locations
- Include an ingress lane of 25-50 feet
- Use green colored pavement to delineate the ingress lane and box area
- Install signage to indicate "No Turn on Red" for motorists
- Install "Yield to Bike" signage to reinforce that bicyclists have right-of-way
- Consistently maintain markings to ensure their effectiveness
- Set the box back one to two feet from the intersection with an advance stop line

Two-stage Turns: Two-stage turn boxes provide a safer and more comfortable way for bicyclists to make left turns at multi-lane intersections and across high-speed arterials. Many bicyclists do not feel comfortable merging across lanes of vehicular traffic to make a left

31 http://nacto.org/cities-for-cycling/design-guide/intersection-treatments/bike-boxes/

32 Dill, J.; Monsere, C.M.; McNeil, N. (2011). "Evaluation of Bike Boxes at Signalized Intersections." http://pdxscholar.library.pdx.edu/cgi/viewcontent.cgi?article=1017&context=usp_fac

Bike boxes increase visibility of bicyclists and allow them to clear an intersection more quickly.
Images from Flickr, Diane Yee (top); Flickr, Eric Fredericks (right)

Two-stage turn boxes facilitate left turns across busy intersections.
Images from Flickr, Payton Chung (left) and Flickr, Seattle DOP (right)

turn, especially where fast-moving traffic is present. A two-stage box provides bicyclists with a designated area and formalizes a left-turn movement via two separate through movements with the corresponding green light. Such facilities have been to shown increase bicyclist comfort, but can result in delay to bicyclists.

Two-stage turn boxes are similar to a standard bicycle box, but they are typically placed in front of the crosswalk allowing bicyclists to easily exit the bicycle lane in which they are traveling and position themselves for the next through movement of the cross street. By contrast, a bicycle box is typically positioned behind the crosswalk for bicyclists on the near side approach of the intersection.

Detailed design guidance for two-stage turn boxes can be found in the NACTO *Urban Bikeway Design Guide*[33], but generally includes the following elements:

- Boxes should be placed in front of the crosswalk to prevent encroachment into the crosswalk.
- Boxes should be placed in a "protected" area, typically between the bicycle lane and the crosswalk.
- Use green colored pavement to delineate the box area.
- Use pavement markings (bicycle stencil and turn arrow) to indicate the preferred left-turn movement.
- Consistently maintain markings to ensure their effectiveness.
- Install signage to indicate "No Turn on Red" for motorists.

Intersection crossing markings: Crossing markings are utilized to clearly indicate the safe path of a travel for a bicyclist through an intersection and into the receiving bicycle lane. They improve predictability of bicyclist movements and further indicate to motorists that they should expect to encounter bicyclists at these locations. Such markings are particularly beneficial at complex, multi-lane intersections.

Detailed design guidance for bicycle boxes can be found in the NACTO Urban Bikeway Design Guide,[34] but generally includes the following elements:

- Markings should match the width of and follow a straight line between the leading and receiving bicycle lane.
- Utilize a combination of dotted line extensions, sharrows, green paint, and "elephant's feet" markings (14-20" square markings) to delineate the path for bicyclists.
- Consistently maintain markings to ensure their effectiveness.

33 http://nacto.org/cities-for-cycling/design-guide/intersection-treatments/two-stage-turn-queue-boxes/

34 http://nacto.org/cities-for-cycling/design-guide/intersection-treatments/intersection-crossing-markings/

Bicycle markings facilitate predictable movements through intersections. Image from Flickr, PeopleForBikes

Transit Stop on Central Expressway (medium- to long-term)

The proposed improvements also include the development of a new transit stop on the north side of Central Expressway, just west of Moffett Boulevard shown on page 4-41. The primary goal of this transit stop is to accommodate the need for additional shuttle and bus service to/from the Transit Center, particularly the proposed public transit service to/from North Bayshore (described in Chapter 6). This stop location would allow transit vehicles to avoid the delays associated with crossing Central Expressway, especially during peak periods, thereby providing significant travel time savings to transit riders. The basic design parameters for the transit stop include:

- Station area between 260-300 feet in length
  - Two 40-foot bus bays
  - Two 60-foot transition zones into and out of the cutout, plus a 60-foot zone between bays to facilitate ingress and egress of buses
- Width of transit cutout is approximately 13 feet
- Bays could be permanently or dynamically assigned to different lines. If the latter were the case, a system of highly visible digital signage and accurate vehicle tracking would be needed, in order to give waiting passengers advance notice.
- A real-time tracking system may also be necessary to alert drivers "upstream" about availability of the bus bays to prevent crowding at the stops.
- Should include a generous sidewalk, shelters with seating, pedestrian-scale lighting and other security features, and detailed signage, including maps, fare and real-time arrival information at each bay
- The proposed transit stop is a *medium- to long-term recommendation* and would work best if a grade-separated pedestrian/bicyclist crossing, or other improvement, of Central Expressway/Moffett Boulevard/Castro Street were implemented. The anticipated level of service at this stop would result in a substantial increase in the number of pedestrian and bicyclist crossings, which would significantly impact intersection operations. Furthermore, the long wait times for transit passengers to cross the intersection could impact transit operations, increase dwell times, and reduce on-time performance.
- An alternative location for an additional loading zone is on eastbound Central Expressway just east of the intersection. However, this would require transit vehicles to perform a u-turn on Central Expressway or find alternative routing to head back west towards Shoreline Boulevard. Such movements would likely increase travel times and might restrict the type of vehicles that could be used. Further evaluation of this location could be included as part of a master planning effort for the station area (Chapter 5).

101 Moffett Boulevard Residential Development

In April 2014, the City approved the 100 Moffett Boulevard Development, a 184-unit mixed-use apartment complex. The project is currently under construction and is estimated to be completed in 2016. The project includes significant changes to the Steirlin Road interface with Central Expressway, including removal of the access road to Central Expressway and creation of a public plaza and pedestrian and bicycle paseo connecting to Stierlin Road. In addition, changes are proposed for Moffett Boulevard, including a bicycle lane, turn lane, and signal improvements. If the transit stop were to be implemented, modifications would likely be required on Central Expressway near the 100 Moffett Boulevard development.

Coordination with Regional Stakeholders

Central Expressway is part of the County of Santa Clara's Expressway System and is controlled by the County. Any changes to Central Expressway will require approval and support from the County. Furthermore, intersection changes, particularly signal timing changes, have the potential to impact Caltrain service. Management of the railroad tracks is subject to the guidance and requirements of Caltrain, the Federal Railroad Administration, and the California Public Utilities Commission.

To implement any short- and long-term changes to this area will require close coordination with multiple stakeholders. The City has already had productive dialogue with the County and Caltrain, yet further collaboration among all stakeholders is needed. For example, the City should continue to work with the County as part of the *Expressway Plan 2040*[35] and Caltrain as part of the Caltrain Modernization Program.[36] Together, all parties should collectively advocate for additional local and regional funding to improve Central Expressway and the Central Expressway/Moffett Boulevard/Castro Street intersection. Long-term solutions will also be addressed as part of the station area master planning process.

35 http://www.sccgov.org/sites/rda/plans/expyplan2040/Pages/study.aspx
36 http://www.caltrain.com/projectsplans/CaltrainModernization.html


TO
SAN FRANCISCO
39 8/10 MI.
MOUNTAIN VIEW
ELEVATION
76 FEET

CHAPTER 5

MOUNTAIN VIEW TRANSIT CENTER

The Mountain View Transit Center is a key local and regional intermodal facility in the heart of historic Downtown Mountain View. The Transit Center houses the Caltrain commuter rail and VTA light rail stations, a loading area for buses, that includes both public and private shuttle services, and commuter parking. Taxi services are also available at this station, as well as short- and long-term bike parking and a Bay Area Bike Share station.

Shuttle congestion during the peak loading periods.

OVERVIEW

In recent years, the importance of the Transit Center has grown substantially. It is the third most utilized station in the Caltrain system, largely because it is the closest Baby Bullet station to many Silicon Valley employers and has become a major regional node for employer shuttles. It is also a unique station because it serves as the northern anchor for the downtown commercial core and is surrounded by existing single and multi-family and newer medium density multi-family housing. Current issues associated with operation and design of the station area include the following:

- An increasing number of shuttle services to/from North Bayshore and other Mountain View employment areas, as well as the larger Silicon Valley region. This has resulted in shuttle vehicle congestion, particularly during the morning peak (7:00 a.m. to 10:00 a.m.), when there are more than 100 buses and shuttles utilizing the Transit Center.
- Current Caltrain ridership, and anticipated future growth, resulting in crowded and constrained station conditions (both on and accessing the station platforms)
- Inefficient shuttle services and routing, with duplicative service and low utilization for some private shuttles.
- Conflicts between passengers and transit vehicles in the parking lot, most notably around the pick up and drop off areas.
- Insufficient bicycle parking and facilities to meet existing and future demand.
- Delays and other constraints for bicyclist and pedestrian access across the Caltrain tracks and Central Expressway.
- General traffic congestion associated with the Central Expressway/Moffett Boulevard/Castro Street intersection and Caltrain tracks, particularly related to frequent train movements and gate down time.

In response to these issues, this study proposes a package of targeted short-term recommendations to address the immediate challenges regarding the operations and management of the Transit Center. The study also describes the need to develop a long-term community vision for the station area and how it will best meet the needs of not only Mountain View, but also the increasingly dynamic transportation needs of the region. As discussed in this chapter, this study recommends a separate comprehensive planning study for the Mountain View Transit Center.

Passenger loading in the parking lot impacts circulation and emergency vehicle access.

Congested bike racks and bicycles locked to parking signs.

Wayfinding is diverse and often uncoordinated.

The Central Expressway/Moffett Boulevard/ Castro Street intersection is heavily used by all modes.

SHORT-TERM IMPROVEMENTS

To guide the development of the short-term recommendations, a number of key principles were adopted based on stakeholder input analysis of the station area:

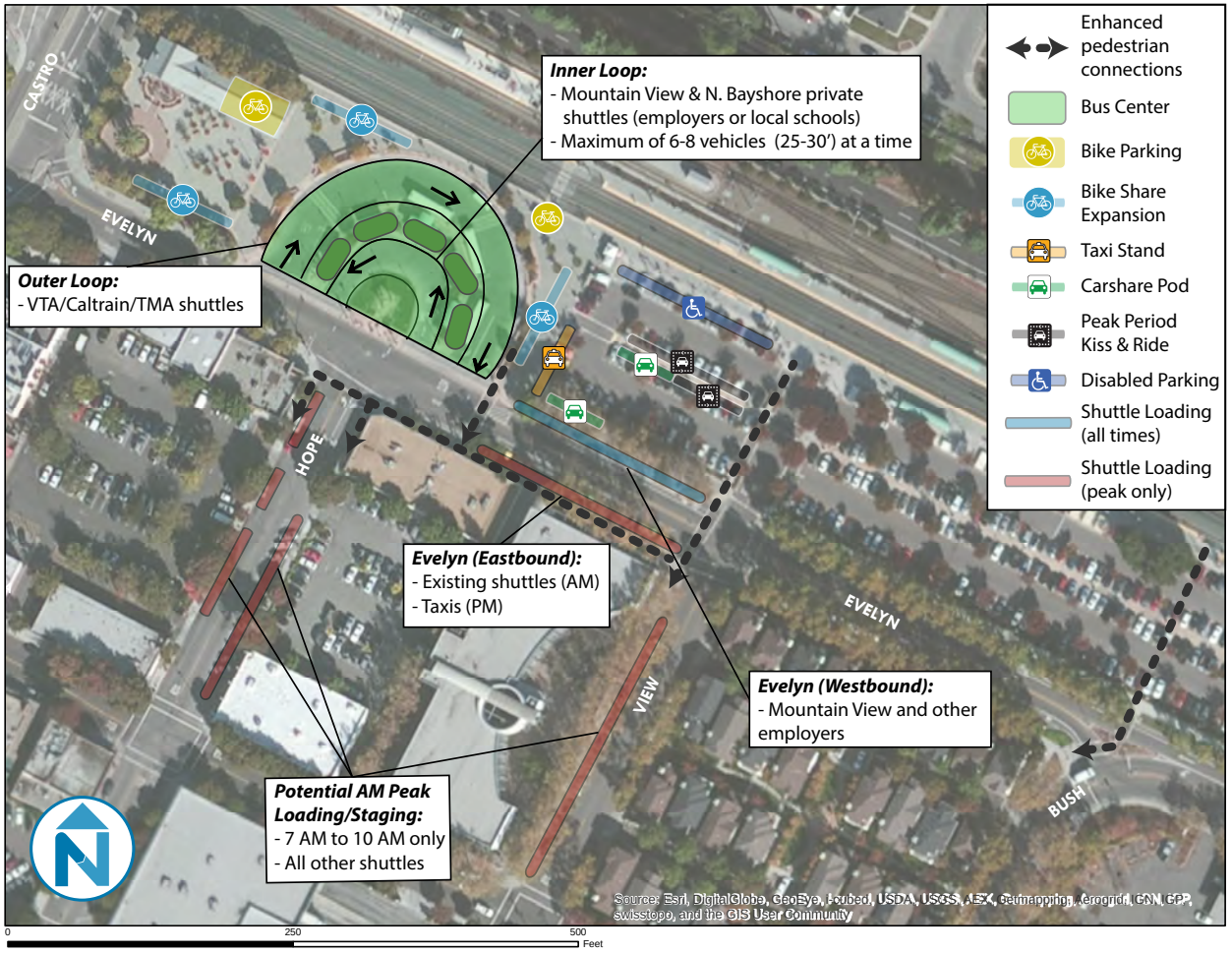
- Retain current location for VTA routes and other public services, as current VTA operations work efficiently.
- Better manage employer shuttle operations.
- Invest in changes that support people movement rather than vehicle movement and adapt the shuttle operations to those investments.
- Identify and prioritize cost-effective investments.
- Minimize loading and traffic impacts on adjacent residential neighborhood streets.
- Maximize investments in effective bicyclist and pedestrian access.
- Improve customer travel information.

The short-term recommendations for the Transit Center include pedestrian circulation improvements, relocating private shuttle pick-up/drop-off locations, and additional station amenities. Figure 5-1 shows the short-term improvements and the proposed changes to the Transit Center's layout.

SHUTTLE OPERATIONS AND LOADING

The following short-term changes are recommended to improve shuttle and transit operations and loading. These recommendations are designed to not only address immediate challenges, but also enable the City to proactively manage ongoing growth in shuttle activity.

FIGURE 5-1 TRANSIT CENTER SHORT-TERM IMPROVEMENTS



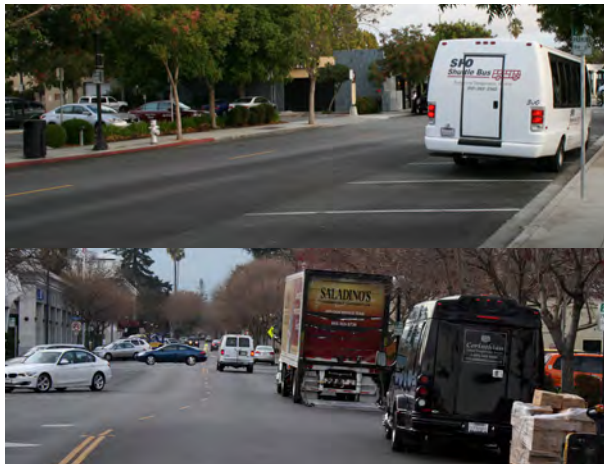
Outer Loop

At all times of the day, the Outer Loop should only be open to VTA buses, existing Caltrain public shuttles, Mountain View Community Shuttle vehicles and Mountain View TMA (MVgo) shuttles. No other operator should be allowed to utilize these loading bays unless VTA, Caltrain, the Community Shuttle, and/or the TMA reduce operations.

Inner Loop

In the morning, only Mountain View employer shuttles, along with local school shuttles, will be eligible to use the inner circle. It is recommended that a maximum of 6-8 vehicles be allowed at one time and only those that are less than 30 feet long. Examples of eligible shuttles include LinkedIn, Google, SSL, Girls Middle School, and Saint Francis High School. During the evening period (with shorter drop off times), all private shuttles would be eligible to use the inner loop, although usage should be monitored for future congestion levels.

Taxi and shuttle loading on Evelyn Avenue should be preserved.



Private shuttles currently use Hope Street for vehicle staging. A formal loading process would reduce loading impacts on the neighborhood.

Evelyn Avenue

Other Mountain View employers will be eligible to use the westbound side of Evelyn Avenue. This space should be able to continue to accommodate shuttles for Microsoft (currently utilizing this space), NASA, and other employers. Eastbound Evelyn Avenue from Hope Street to View Street should be used for Yahoo and Oracle. As is now the case, this area is will be used for shuttle bus operations in the morning peak period and will revert to taxi operations at 10 a.m. Shuttle loading will still be available on Evelyn Avenue westbound in the evening period.

Hope and View Streets

Portions of Hope Street and View Street should be reserved for shuttle operations in the peak morning period on weekdays (7 a.m. to 10 a.m.). Normal parking restrictions will be in place at all other times. The new loading area could be used by a variety of employer shuttles, such as Apple, HP, and Netflix. New signage would need to be installed stating "Shuttle Loading Only – 7 a.m. to 10 a.m. Weekdays." Specific street segments include:

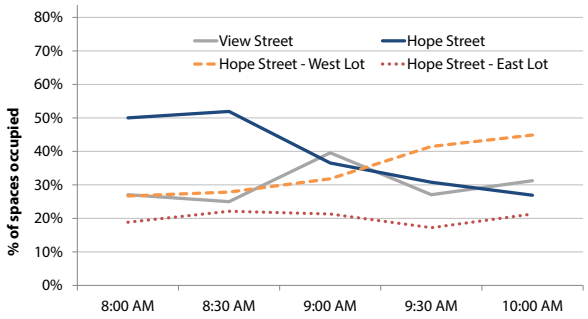
- The west side of Hope Street, which would result in the loss of approximately nine public parking spaces during the morning peak period.
- The east side of Hope Street could be used for vehicle staging and loading (as needed) for operators who arrive early and have no other place to park. This would result in the loss of 14 public parking spaces during the morning peak period.
- The west side of View Street could also be utilized for additional morning peak period loading and staging (14 spaces).

There is adequate parking supply in the immediate area to accommodate the existing morning parking demand on these blocks. Figure 5-2 highlights the observed parking utilization on Hope Street and View Street, as well as in the two lots adjacent to Hope Street. Counts were taken on September 30th and October 1st of 2014. Parking occupancies on Hope Street and View Street do not exceed 52%, and the off-street lots do not exceed 45%.

Active Management

Given the increasing complexity of shuttle operations at the Transit Center, the City should also explore strategies, with VTA and the TMA, for "active" management of the area, potentially including a staffed position to monitor and enforce loading operations during peak periods.

FIGURE 5-2 PARKING OCCUPANCY ON HOPE AND VIEW STREETS



BICYCLE AND PEDESTRIAN ACCESS

The following short-term changes are recommended to improve bicycle and pedestrian access at the Transit Center.

- Improve safety throughout the station area with implementation of high-visibility crosswalks at Hope Street/Evelyn Avenue, View Street/Evelyn Avenue, and Bush Street/Evelyn Avenue.
- Evaluate pedestrian signal timing at Hope Street/Evelyn Avenue to ensure adequate crossing time and the most direct crossing configuration for higher volumes of pedestrians.
- Provide a new pedestrian access point through the existing fence on Evelyn Avenue at Bush Street, as well as a marked pedestrian pathway from this gateway to the southern end of the Caltrain platform.
- Provide green-backed bicycle sharrow markings on View Street between Evelyn Avenue and California Street, which is a key bicycle route and connection.
- Enhance bicycle connections to the Stevens Creek trail with additional wayfinding and lighting improvements along Evelyn Avenue, and installation of crosswalks and pedestrian/bicycle signals at the signalized intersection of Evelyn Avenue/State Route 85 on-ramp/Stevens Creek Trail. Explore the potential for the addition of high-visibility green paint to existing bicycle lanes on Evelyn Avenue to better manage conflict points at intersections and driveways.

An additional pedestrian access point in the parking lot would improve connections to Evelyn Avenue and nearby housing.

High-visibility crosswalks can enhance pedestrian access to and from the station.
Right image from Flickr, City of Indianapolis Mayor's Office; left image from Flickr, Richard Masoner

BICYCLE AMENITIES

The following short-term changes are recommended to improve bicycle facilities at the station.

- Expand the number of bike share pods on either side of the bus loading center. This recommendation is dependent on the timing and scope of expansion of Bay Area Bike Share into the North Bayshore area and greater Mountain View. Other bicycle sharing systems should also be considered and investigated.
- Evaluate the installation of a staffed bike station, including secure bicycle parking, bicycle repairs, and associated retail, at the existing station house building. There is currently a shared access bike storage facility located here that could be retrofitted and expanded.
- Provide additional bicycle racks adjacent to the station platforms, as well as e-bike lockers, to increase short-term and secure bicycle storage capacity and turnover.

Additional lockers and racks will maximize bicycle access to the station and help to reduce capacity issues on Caltrain.
Right image from Flickr, Oran Viryincy; left image from Flickr, Richard Masoner

The existing station house building offers an opportunity for a staffed bike station, which can increase secure parking and provide an amenity to riders. One example is the bike station at 4th and King in San Francisco.
Image from Flickr, ITDP

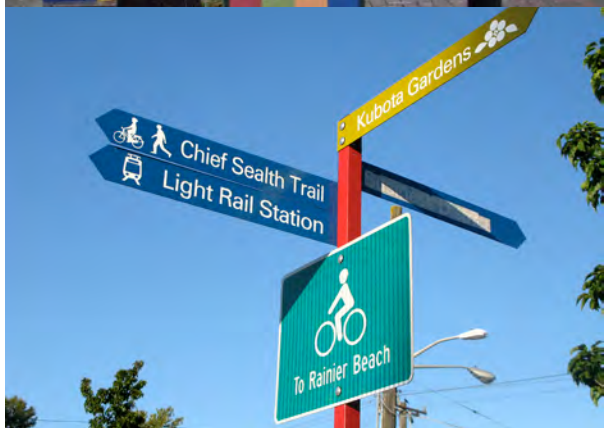
STATION AMENITIES

The following short-term changes are recommended to improve passenger amenities and information at the station.

- Reallocate a limited number of existing parking spaces to a peak period "kiss-n-ride" area. The kiss-n-ride area would only be in place from approximately 7:30 a.m. to 9:30 a.m. and 4:00 p.m. to 6:00 p.m. During the day, these spaces would revert to standard parking or short-term parking (i.e. 4-hour limit). The benefits of a "kiss-n-ride" area include:
  - Better accommodation of passenger drop-off and loading that currently takes place in the parking lot during peak period
  - Improved pedestrian safety in the parking lot
  - Reduced impacts/delays to vehicle circulation in the parking lot
  - Increased availability of parking spaces for Caltrain passengers who arrive/depart outside of peak commute periods
- Provide car share pods in the transit center parking lot to facilitate last-mile connections. It is unlikely that car sharing would play a significant role in daily commuting to/from North Bayshore, but it would facilitate off-peak trips and maximize the value of those parking spaces, allowing each car share parking space to accommodate multiple vehicle trips per day. Car share pods would also be available to downtown patrons and employees.
- Improve signage, wayfinding, and real-time information throughout the station area to improve user-friendliness, facilitate transit connections, and ensure that casual and daily users can easily navigate the station area. For example, the existing passenger information provided within the station house is too isolated and should be relocated to a prominent location near the station platforms. These improvements are vital as more and more employers connect their shuttles to the Transit Center.

A peak period Kiss-n-Ride area will reduce illegal passenger loading in the parking lot.
Image from Flickr, Brett L.

Car sharing can facilitate last-mile connections and provide an alternative for short, midday trips.
Image from Flickr, Timothy Volmer



A well-coordinated wayfinding system will improve connections to transit services, bicycle routes, and local destinations.
Image from Flickr, Oran Viryincy

LONG-TERM IMPROVEMENTS

In addition to short-term needs, the City and its regional partners recognize that there are significant longer-term challenges facing the station area. Increased rail service and usage will necessitate a reimaging of the Transit Center's purpose and role in the local and regional transportation system.

The Corridor Study undertook a preliminary assessment of mid- to long-term improvements that would help improve station access and transit capacity. These concepts included a potential elevated walkway and concourse over the station and Central Expressway and expansion of the Transit Center. These improvements would be costly and may not effectively integrate with other future station upgrades. Additionally, feedback from Caltrain and station users indicated that under-passes rather than elevated structures may better serve pedestrians and bicyclists.

As a result of this initial assessment, it is recommended that a comprehensive Transit Center master plan for the Caltrain Station and surrounding area be developed. The need for a master plan is timely given a number of issues that will affect the operation of the station in the near future, summarized in the following section.

PLANNING ISSUES

The Transit Center is affected by planning issues that relate to increasing demand for transportation services and land uses in the vicinity. Key elements of this demand include the following:

- **Increased rail transit service.** Caltrain service is expected to increase by 40% with electrification (increased bi-directional frequency) and VTA service is expected to double in order to provide express service to BART at the new Milpitas station. In the long term, high-speed rail is also proposed to operate up to eight trains per hour in the corridor. Key implications for the Transit Center include:
  - Increases in gate down time, and subsequent delays, at Castro/Moffett/Central intersection
  - Increases in passenger activity that will create greater potential for conflicts between rail activity and motorists
  - Additional safety challenges associated with high-speed service
- **Increased transit ridership and activity.** Additional capacity and transit services, as well as the City's goal to reduce SOV trips, are expected to contribute to an increase in transit ridership. Caltrain ridership to and from Mountain View could increase from approximately 4,200 average weekday passengers in 2014 to more than 10,000. Similarly, VTA average weekday ridership could increase to up to 3,000 with increased service. Key implications for the Transit Center include:
  - The need for Caltrain platform expansion to accommodate demand
  - Increased numbers of bicyclists/pedestrians crossing the tracks and adjacent intersections
  - Increased parking demand at the station and potential for spillover into neighborhoods
  - Greater demand for "last-mile" transit, bicycle and other services
- **Increased last-mile shuttle services.** Increased development and stricter regulations from cities requiring employers to provide private shuttles as part of their transportation demand management (TDM) programs will continue to impact circulation at the Transit Center. Key implications of this trend include the need for:
  - Additional shuttle loading areas at the Transit Center
  - Better management of loading activity
  - Enhanced coordination or consolidation of services with less duplication of service
  - Limits to the number of shuttles in the area such as through a permit system
- **Increased bicycle demand and activity.** According to the 2030 General Plan and the Bicycle Transportation Plan, the City of Mountain View is planning for enhanced bicycle mobility throughout the City. Key implications for the Transit Center include the need for:
  - Additional space for bike parking/storage at the Transit Center
  - Additional space for bike share pods
  - Accommodations for bicyclists across Central Expressway
  - Additional high-quality, protected bicycle lanes to/from station such as along key bicycle routes
- **Increased traffic volumes.** Planning efforts by both the City of Mountain View and Santa Clara County anticipate ongoing increases in traffic volumes along roadways in the vicinity of the Transit Center. These increases reflect ongoing development and employment expansion within Mountain View, as well as the Silicon Valley region.

Key potential implications of the growth in traffic volumes include:

- Additional traffic volumes at the Central Expressway/Moffett Boulevard/Castro Street intersection
- Increased conflicts with pedestrians and bicyclists resulting from exposure to traffic
- The need for more efficient shuttle routing around the Transit Center
- Improved facilities for higher occupancy modes

- **Increase in demand for housing, employment, and services near station.** Ongoing employment growth throughout the Bay Area, as well as regional funding requirements that prioritize development near transit nodes, will only increase the demand for development near the Transit Center. The implications of this increased demand may include:
  - Higher-density, mixed-use development on the existing station parking lot and/or parcels near the Transit Center
  - Potential development of a new parking structure on existing station lot
  - Enhanced parking management around the Transit Center to reduce spillover impacts into neighborhoods

POTENTIAL IMPROVEMENTS

Potential alternatives for improving station capacity, station access, parking and vehicle operations, and other issues are inter-related and will require a comprehensive evaluation to determine the best plan. Concepts for the station and Transit Center that could be addressed in a comprehensive master plan include the following:

- Grade separation of Castro Street at the Caltrain tracks and/or Central Expressway, with separate pedestrian/bicycle undercrossing
- Grade separation of pedestrian/bicycle movements (over/under) between the Caltrain platforms, light rail platforms and Transit Center, and across Central Expressway
- Improvements to the Caltrain platform improvements such as longer, wider, level boarding facilities, and upgraded shelters
- Expansion or reconstruction of the Transit Center to handle increases in shuttle and transit service
- Improved pedestrian/bicycle access to platforms and Transit Center from the surrounding neighborhoods
- Increased capacity of bicyclist amenities through new bike sharing pods, a bike station, and/or additional bike parking at the station
- Construction of a parking structure to accommodate existing or expanded parking
- Development of a car sharing strategy to reduce parking demand and increase the efficiency of parking spaces at the station
- Potential transit-oriented housing or mixed-use development on a portion of current parking area
- Other elements such as electric vehicle charging infrastructure, public art, and improvements to the station's role as a gateway to downtown Mountain View

The Transit Center parking lot is in high demand, but parking could be reconfigured to accommodate housing or mixed-use development.

A long-term strategy to address Caltrain capacity would address platform crowding.
Image from Flickr, Richard Masoner

LONG-TERM RECOMMENDATIONS

While details of the potential scope for a comprehensive Transit Center Master Plan will need to be developed, it is estimated that the plan could be completed in 12 to 18 months. This effort will require a significant amount of coordination between the City, VTA, Santa Clara County, Caltrain, California High-Speed Rail, and other stakeholders. Development of a plan in that time frame would be particularly timely in terms of upcoming funding programs such as Caltrain and California High-Speed Rail capital improvements, cap-and-trade funding, and a possible 2016 Santa Clara County transportation sales tax measure. Key products of the master plan could include:

- A site master plan for the Transit Center and larger station area, including integration with the Downtown Plan
- A plan for improved transit facilities including platforms, Transit Center, pedestrian and bicyclist access, bicycle facilities
- Evaluation and recommendations regarding Castro Street and/or Central Expressway grade separation options to address traffic, property and business impacts
- Evaluation and recommendations regarding parking structure options and potential redevelopment of the Caltrain parking lot
- Identification of capital costs, funding strategy, phasing and implementation plan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Shuttle Connect
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CHAPTER 6

TRANSIT SERVICE PLAN

This chapter provides an overview of the proposed transit service plan for the Shoreline Boulevard corridor. The 2013 Shoreline Transportation Study found that the existing transit and private shuttle network would need to be expanded to meet the needs of future employment growth. Other challenges were also identified, including crowding at the Transit Center. These findings were confirmed by the additional analysis conducted as part of this study (see Chapter 3).

SERVICE OBJECTIVES

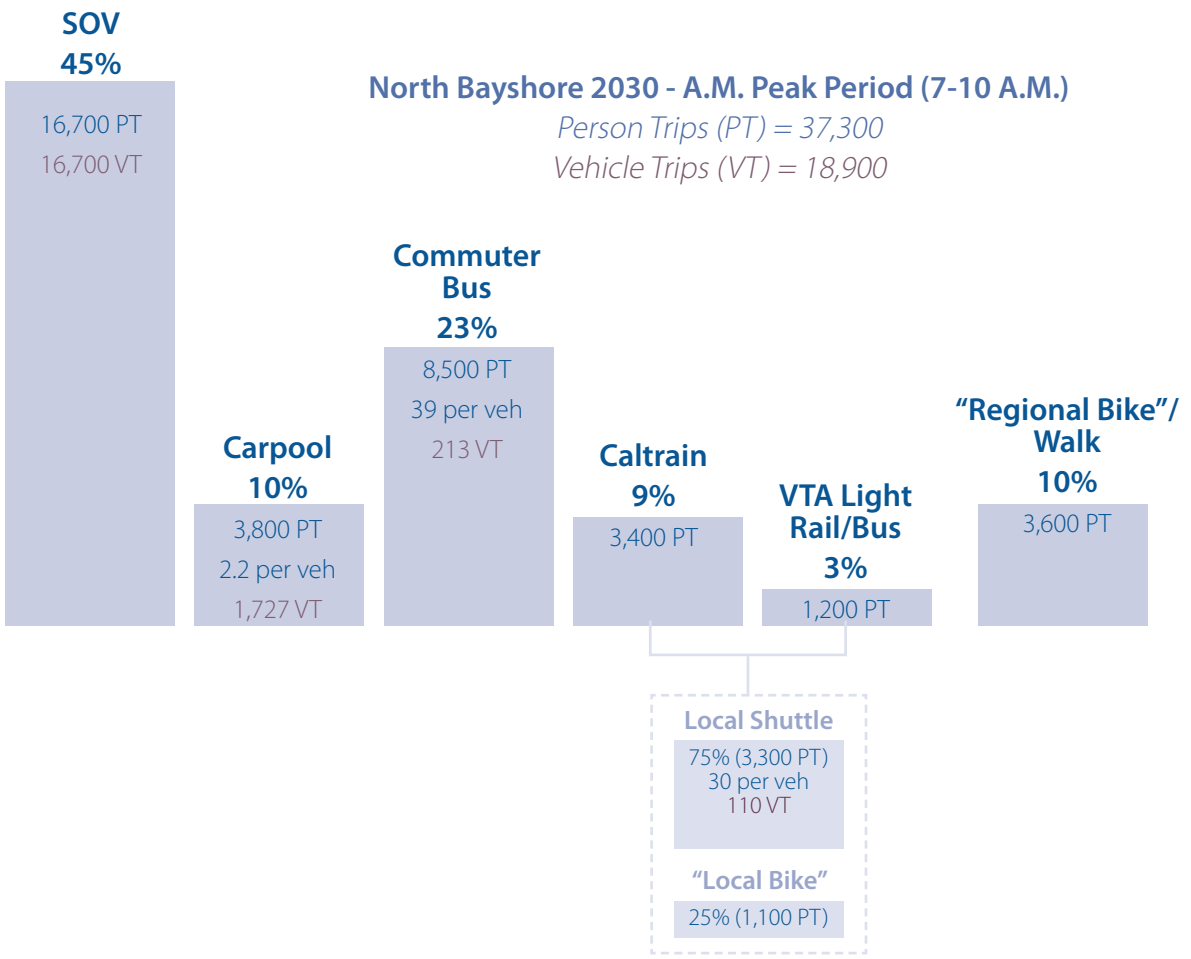
The transit service plan in this chapter articulates a vision for a consolidated shuttle system that would be open to the public. It is in flexible in its design in order to integrate and build upon short-term changes being proposed by the newly formed by the Mountain View Transportation Management Association (TMA). The overall objectives of the service plan are to:

- Consolidate and expand North Bayshore shuttle services
- Improve efficiency of transit resources
- Reduce crowding and improve shuttle operations at the Transit Center
- Better accommodate future transit demand
- Provide a public benefit to Mountain View employers, residents, and businesses

POTENTIAL NORTH BAYSHORE RIDERSHIP

Figure 6-1 shows the adopted 2030 mode split targets for North Bayshore, as endorsed by the Mountain View City Council and embedded in the North Bayshore Precise Plan. It reflects the 45% SOV target and the 55% non-SOV target rate. The 55% non-SOV share is somewhat flexible in its allocation between carpool, local and regional transit, biking, and walking. Figure 6-1 reflects one possible scenario for the non-SOV modes, assuming approximately 4,600 person trips in the morning commute peak period (7:00 a.m. to 10:00 a.m.) at the Transit Center.

FIGURE 6-1 NORTH BAYSHORE 2030 MODE SPLIT TARGETS (A.M. PEAK PERIOD)



CORRIDOR TRANSIT CAPACITY

CALTRAIN

Current Demand/Capacity

Based on the most recent available data, the average weekday ridership on Caltrain at Mountain View is 4,274, up approximately 10% from 2013 (3,876 average weekday ridership). This level of ridership makes Mountain View the third-busiest Caltrain station, with higher demand than San Jose Diridon.

Figure 6-2 shows numbers of Caltrain boardings and alightings at Mountain View in each direction of travel during both the morning (6-10 a.m.) and evening (4-7 p.m.) peak periods. Figure 6-3 highlights the distribution of Caltrain activity at Mountain View throughout the day.

FIGURE 6-2 PEAK PERIOD BOARDINGS AND ALIGHTINGS IN EACH DIRECTION

		Southbound	Northbound
AM*	Ons	112	1,488
	Offs	1,601	207
PM**	Ons	217	1,452
	Offs	1,254	91

* 2014 data

** 2013 data

Analysis of total Caltrain capacity and demand over the entirety of each peak period indicates that overall capacity currently exceeds demand (Figure 6-4), although the gap is narrowing as ridership continues to grow. Certain Baby Bullet or Limited trains carry full passenger and bicycle loads over much of their busiest trips. For example, Figure 6-5 shows loads and capacity on Baby Bullet express Train 324, arriving in Mountain View from the north at 8:58 a.m. Train 324 departs San Francisco with roughly half its seats filled, and is nearly full by the time it departs Millbrae, where connections can be made from BART. About 46% of passengers on that train alight at Palo Alto, and nearly all remaining riders disembark at Mountain View. While other trips are not as crowded as Train 324, this pattern – high loads between Millbrae and Palo Alto – is typical for both southbound morning and northbound evening trips.

FIGURE 6-3 CALTRAIN RIDERSHIP AT MOUNTAIN VIEW STATION (2013)

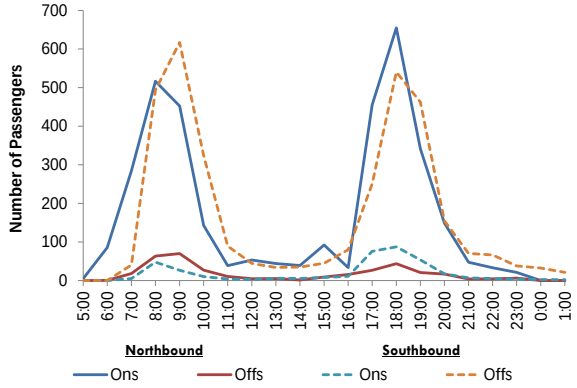
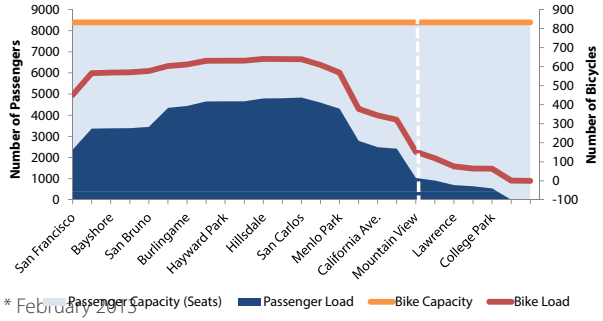
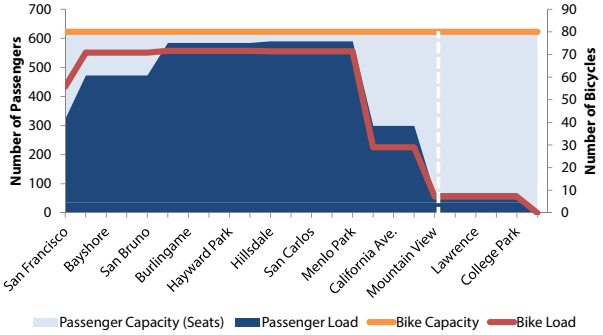


FIGURE 6-4 LOADS AND CAPACITY FOR ALL SB TRAINS, AM PEAK (6-10 A.M.)*



* February 2013

FIGURE 6-5 LOADS AND CAPACITY ON SB BAY BULLET #324*



* February 2013

This suggests that passengers traveling to Mountain View from the north may have difficulty finding a seat, while there is capacity available for those traveling from the south. It further suggests that if growth in Caltrain ridership continues to outpace growth in capacity, commuters traveling to Mountain View from the north will likely be unable to find a seat on Caltrain.

Future Capacity

Caltrain currently operates up to five trains per hour in each direction during peak periods, with most trains consisting of five cars with approximately 650 total seats, depending on car make.[1,2] In the near term, Caltrain plans to purchase additional cars in order to operate six-car trains on the busiest trips. According to Caltrain staff, the sixth car should add 120 seats, for a total of 770 seats per train. With the new car, however, a certain number of platforms will need to be modified to accommodate the trains.

By 2020, as part of the Caltrain Modernization (CalMod) program, the agency plans to begin operation of six-car Electric Multiple Unit (EMU) trainsets with a total

1 Per comments to the Peninsula Corridor Joint Powers Board (JPB) Citizens Advisory Committee (CAC) by Director of Rail Transportation Michelle Bouchard, February 19, 2014.

2 2013 Caltrain Annual Passenger Counts, page 7. http://www.caltrain.com/Assets/Stats+and+Reports/Ridership/2013+Annual+Ridership+Counts.pdf

capacity of approximately 600 seats.[3] While the seated capacity of each train would be reduced, electrification would allow Caltrain to operate up to six trains per hour per direction,[4] and increase the total number of weekday trips from 92 to 114.

Over the longer term, Caltrain plans to operate eight-car trains. According to Caltrain staff, however, 80% of station platforms (including Mountain View) will have to be lengthened in order to do so. In some cases, this will require extensive reconfiguration of both the station and surrounding area.

The maximum numbers of seats available aboard Caltrain during peak hours over several time frames is shown in Figure 6-6. The near-term and longer-term estimates assume that all peak-hour trains would consist of six cars. More capacity would be available with the eight-car plan noted above.

It is also important to note that these numbers reflect ***seated*** capacity only – the 2014 ridership report indicates that the busiest trains can carry up to 143% (#319 - a.m. northbound) and 146% (#376 - p.m. southbound) of seated capacity.[5] Furthermore, it is worth highlighting that the Proposed Project in the Peninsula Corridor Electrification Project Draft EIR does not assume level boarding, which could significantly reduce travel times and allow for more trips and flexibility within the schedule.

FIGURE 6-6 TOTAL CAPACITY (SEATS ONLY) IN THE PEAK PERIOD (7-10 A.M.)

Direction	Trains / Hour	Peak Period Trips (3 hours)	Avg. Seated Capacity / Train	Peak Capacity
Current				
SB	5	15	650	9,750
NB	5	15	650	9,750
Total				**19,500**
Near-term (additional car purchase)				
SB	5	15	770	11,550
NB	5	15	770	11,550
Total				**23,100**
Medium-term (2020 CalMod)				
SB	6	18	600	10,800
NB	6	18	600	10,800
Total				**21,600**
Long-term				
SB	8	24	600	14,400
NB	8	24	600	14,400
Total				**28,800**

3 Peninsula Corridor Electrification Project Draft Environmental Impact Report (DEIR). See footnote 10 on page ES-21. http://www.caltrain.com/Assets/Caltrain+Modernization+Program/DEIR/Executive+Summary.pdf

4 According to Bouchard, Caltrain could operate up to 12 trains per hour, but all trains would have to make all stops, requiring the elimination of Baby Bullet express and limited-stop services.

5 http://www.caltrain.com/Assets/_MarketDevelopment/pdf/2014+Annual+Passenger+Count+Key+Findings.pdf

Figure 6-7 shows one possible range of estimates for Caltrain ridership at the Mountain View station. These are basic estimates of the number of alightings during the morning peak at Mountain View, as well as an estimate of the share that then travel to the North Bayshore area. These represent significant increases in Caltrain demand for North Bayshore over the current levels of demand.

As highlighted by Figure 6-5, the key question in regards to these estimates is whether there is adequate system capacity for Caltrain to accommodate this level of increase in riders at the Mountain View station. As it stands now, some of the southbound bullet trains are almost at capacity once they leave Millbrae station and until they arrive at Palo Alto station.

Chapter 5 discusses a recommendation to engage in a comprehensive planning effort to address long-term transit capacity issues at Mountain View station.

FIGURE 6-7 LOW AND HIGH ESTIMATE OF MOUNTAIN VIEW AND NORTH BAYSHORE CALTRAIN RIDERSHIP (A.M. PEAK)

Direction	Trains / Hr.	Peak Period Trips (3 hours)	Avg. Seated Capacity / Train	Peak Capacity	Per Trip Off at MV	AM Peak Off at MV	MV % of Capacity	% to North Bayshore	Total to North Bayshore
Current*									
SB	5	15	650	9,750	130	1,601	20%	28%	548
NB	5	15	650	9,750	16	207	2%	23%	55
Total				**19,500**					**603**
Low Estimate									
SB	6	18	600	10,800	250	4,500	42%	40%	1,800
NB	6	18	600	10,800	50	900	8%	30%	270
Total				**21,600**					**2,070**
High Estimate									
SB	8	24	600	14,400	300	7,200	50%	40%	2,880
NB	8	24	600	14,400	75	1,800	13%	40%	720
Total				**28,800**					**3,600**

*Caltrain ridership data collected (1/22/13 – 2/22/13)

VTA LIGHT RAIL

For the VTA light rail system, as of April 2013, average weekday numbers of boardings at Mountain View Station were 1,226, and average weekday alightings were 1,181. Currently, VTA operates four trains per hour in each direction during peak periods. VTA light rail vehicles have a seated capacity of approximately 65 and a total capacity of 230, and may be arranged in consists of up to three cars. Current VTA light rail capacity substantially exceeds demand even during peak periods.

In the near term, VTA plans to double-track the single-track segment of light rail right-of-way leading to and from Mountain View Station. This would allow for more frequent service. In the medium term, the agency plans to initiate "Red Line" express service between Alum Rock and Mountain View, connecting to BART at the Milpitas Station after it opens in 2017. The express service might only make one or two stops (e.g. at the Lockheed Martin station) between the Old Ironsides and Downtown Mountain View stations. The express service would be in addition to the existing Mountain View-Winchester local service.

Based on the Light Rail System Analysis, VTA may operate four trains per hour on each line, for a total of eight trains per hour. Three-car consists might be operated on the local line and two-car trainsets on the express line. This would result in a total of 20 cars, 1,300 seats, and total capacity for 4,600 passengers per hour, more than sufficient for projected levels of demand for Mountain View and North Bayshore.

2030 TRANSIT SERVICE PLAN

The transit service plan described below offers a vision for transit service at full build out of the North Bayshore Precise Plan. As discussed, this plan may be implemented in phases depending on how demand for such services grow, the installation of new infrastructure on Shoreline Boulevard, and the management of the service.

The recently formed TMA is developing more immediate concepts for improving public shuttle service and streamlining private operations. Initial short-term concepts include a new North Bayshore route timed to Caltrain service, and eventually a minimum of three routes serving North Bayshore, two routes serving Whisman light rail, and one route serving San Antonio Caltrain.

The service plan described below is consistent with those concepts, and the City, VTA and the TMA should continue to work together on the service plan.

ROUTES

This transit service plan is designed to replace the existing Caltrain Shoreline shuttle service, as planned by the Mountain View TMA and North Bayshore employers, and provide an attractive public alternative that they might operate in lieu of continued company shuttle services.

In order to achieve the target capacity of at least 1,000 passengers per hour, the alternative assumes an average maximum load on each bus over the three-hour peak period of 50 to 55 passengers.[6] At full system build out, this would require use of larger vehicles, at minimum standard 40-foot motor coaches, and potentially some 60-foot articulated buses.

At 50 to 55 passengers per vehicle, 1,000 trips could be accommodated per hour in the peak direction using 20 buses. This would result in an average headway of three minutes, allowing the service to meet trains in the peak periods. Some bunching or "platooning" may be desirable during the morning peak period, in order to time departures to Caltrain arrivals and more easily accommodate loads transferring from Caltrain. However, bunching should be limited so that it does not adversely impact on-time performance. In the Shoreline Boulevard corridor, bunching would be mitigated by a) the corridor's relatively short length, b) routings that allow most buses to avoid at-grade crossings of Central Expressway in one or both directions, and c) transit-only lanes in the most congested segment of the corridor.

The suggested service plan consists of four routes: a "trunk" or main line, and three "branch" routes. Stops on the trunk route would be within one-quarter to one-third of a mile of nearly all North Bayshore destinations, while branch routes would provide more direct service to those destinations that are some distance from the trunk route. Because the routes would overlap between the Transit Center and North Bayshore area, passengers with destinations along a branch route, but who would be willing to walk some distance could "take the first bus that comes along" rather than wait for a bus providing direct service.

The alignments of the four routes are shown in Figure 6-8. For purposes of description, the routes have been identified using colors:

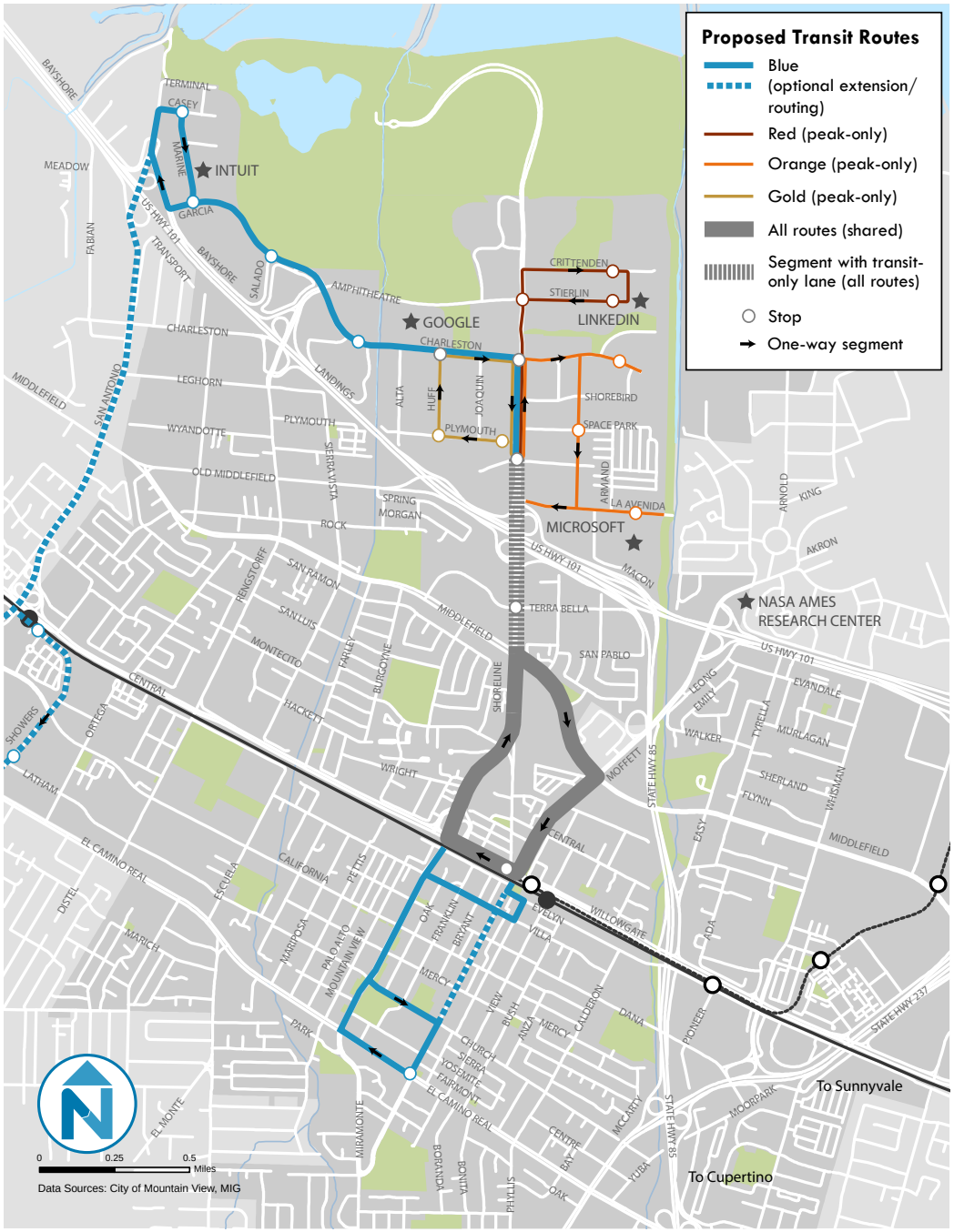
6 Departing the Transit Center in the morning, and arriving in the evening.

- The *Blue Line* would operate all day, seven days a week in both directions between El Camino Real and Castro Street and Marine Road and Casey Avenue primarily via Shoreline Boulevard, Charleston Road, and Garcia Avenue.[7] It would operate every 7.5 minutes during peak periods[8] (resulting in eight buses per hour in each direction), every 15 minutes during the mid-day, early morning and evening "shoulder" periods, and during the day on weekends, and every 30 minutes late nights and weekend early mornings and evenings.
- Additionally, the following routes would operate every 15 minutes during peak periods:
  - ***Red,*** from the Transit Center to Crittenden Lane and Stierlin Court;[9]
  - ***Orange***, to Charleston Road east of Shoreline Boulevard, the new north-south connector street proposed to run parallel to Shoreline Boulevard to the east as part of the North Bayshore Precise Plan,[10] and La Avenida Street;
  - ***Gold***, to Plymouth Street and Huff Avenue.

Two variants to the baseline alternative are also proposed:

- During peak periods, the Blue Line could be extended from Casey Avenue to San Antonio Caltrain and the Showers Drive Transit Center via San Antonio Road, and

FIGURE 6-8 MAP OF TRANSIT ALTERNATIVES



7 For purposes of estimating costs, its weekday span of service has been assumed to be approximately 5 a.m. to 1 a.m., reflecting Caltrain hours of operation. Weekend service would operate over a shorter period, assumed to be 7 a.m. to 11 p.m.

8 Assumed to be 7 a.m. to 10 a.m. and 4 p.m. to 7 p.m.

9 This route might also operate during events at Shoreline Amphitheater.

10 If such a street is not constructed, service could operate via Shoreline Boulevard, or separate routes could serve Charleston Road east of Shoreline Boulevard and La Avenida Street.

- During off-peak periods, the Blue Line could terminate at the Transit Center rather than El Camino Real and Castro Street.

As Figure 6-8 indicates, all branch routes would operate in the vicinity of the Transit Center via the clockwise loop of Middlefield Road, Moffett Boulevard, Central, and Shoreline Boulevard. In order to access the proposed VTA bus rapid transit stops at El Camino Real and Castro Street, the Blue Line would operate via Middlefield Road, Moffett Boulevard, Central, Shoreline Boulevard, Church and Castro Street southbound, then via El Camino Real, Shoreline Boulevard, Villa Street, Castro Street, Central Expressway, and Shoreline Boulevard northbound.[11]

All lines would turn back using loops at their northern ends; depending on the extent to which the street network is reconfigured as a result of the North Bayshore Precise Plan, short segments of the Red and Orange lines might have to be in existing parking lots, and minor modifications to the lots and lot entrances and exits might be required.[12]

Figures 6-8 and 6-9 also show possible general locations of stops. Stops would be located at major destinations to the south (the Transit Center and El Camino Real) and generally 1,000 to 1,500 feet apart in the North Bayshore area, providing relatively direct access to destinations.

FIGURE 6-9 POTENTIAL STOP LOCATIONS

Stop	Line Served			
	Blue	Red	Orange	Gold
El Camino Real at Castro Street (NW corner w/ NB VTA BRT stop)	■			
Central Expressway at Moffett Boulevard (Transit Center)	■	■	■	■
Shoreline Boulevard at Middlefield Road/Terra Bella Avenue	■	■	■	■
Shoreline Boulevard at La Avenida Street	■	■	*NB only*	■
Shoreline Boulevard at Plymouth Street/Space Park Way	■	■	*NB only*	*SB only*
Shoreline Boulevard at Shorebird Way/Charleston Road	■	■	*NB only*	*SB only*
Charleston Road at Huff Avenue	■			■
Charleston Road at Landings Drive	■			
Garcia Avenue at Salado Drive	■			
Garcia Avenue at Marine Way	■			
Marine Way at Casey Avenue	■			
Shoreline Boulevard at Stierlin Road		■		
1200 Crittenden Lane		■		
2061 Stierlin Road		■		
1200-1230 Charleston Road			■	
New north-south connector at Space Park Way			■	
1085 La Avenida Street			■	
La Avenida Street at Shoreline Boulevard			■	
Plymouth Street just west of Shoreline Boulevard				■
Plymouth Street at Huff Avenue				■
San Antonio Caltrain Station	*Variant*			
Showers Transit Center	*Variant*			
El Camino Real at Showers proposed BRT stop	*Variant*			

Services should be significantly faster than existing Caltrain Shoreline Boulevard shuttle. The time savings is due to the fact that they would take advantage of the capital improvements on Shoreline Boulevard, but also because services would operate bi-directionally, rather than as a large, one-way loop with various branches like the existing Shoreline Boulevard shuttle.

In the most extreme example, passengers currently using the Caltrain Shoreline shuttle to travel between the Transit Center and Terra Bella Avenue can make the northbound trip in just six minutes, but the return trip takes 28 minutes. Under the proposed alternative, the longest trips between the Transit Center and North Bayshore area, to San Antonio Road and Casey Avenue near the Intuit campus, should take no more than about 15 minutes in either direction.

11 Similarly to the clockwise loop of Middlefield Road, Moffett Boulevard, Central, and Shoreline Boulevard, the clockwise loop of Church, Castro, El Camino Real, and Shoreline Boulevard would allow Blue Line buses to avoid a time-consuming crossing of El Camino Real. Southbound BRT passengers, however, would have to cross El Camino Real to access the stop.

12 Caltrain Shoreline shuttles currently use the Crittenden/Stierlin Road loop proposed for the Red Line, including a short segment in a parking lot between the two streets; however, Shoreline service is operated using smaller "cutaway" vehicles, not full-sized coaches. The Gold Line would need to loop through a portion of the existing Microsoft lot off of La Avenida Street.

FARE POLICY

Fare options for Shoreline Boulevard service can be grouped into three basic categories:

- Fare-free
- Discounted fare, relative to VTA service
- Full fare, or consistent with existing VTA fares

The current public transit service in the corridor is fare-free and the initial public service to be operated by the TMA would also be free. It is likely that the future service would also operate fare-free.

Free fare is the policy for all Caltrain shuttles, which are designed to provide connections to and from trains, on which a fare is already paid. More broadly, this is standard practice for "feeder" services designed to provide first- and last-mile connections to longer-distance trunk services. It is also typical of "circulator" services designed to serve short trips within a relatively small area, as potential passengers are generally less willing to pay for a short trip, and may choose other travel options, including driving. For example, while VTA's current adult cash fare is $2, no fare is charged on two VTA connecting and circulator services: the Route 10 Free Airport Flyer[13] and San Jose Downtown Area Shuttle, or DASH.[14]

Another reason to operate fare-free is that on-board fare payment using a farebox is a time-consuming process that lengthens dwell times and running times and can increase operating costs. Fare payment can be handled off-board, using ticket vending machines (TVMs), and on-board using card readers and validators only, rather than a farebox. However, this requires purchase and maintenance of additional equipment, as well as enforcement of a proof-of-payment (POP) policy under which passengers would be required to show proof of payment if approached by a fare enforcement officer.

13 Jointly operated by VTA and the San Jose International Airport.
14 DASH is jointly funded by VTA, San Jose State University, and the Bay Area Air Quality Management District (BAAQMD).

VEHICLE CHARACTERISTICS

The proposed transit service plan assumes use of rubber-tired vehicles (buses) of at least moderate capacity (able to accommodate average peak loads of 50 to 55 passengers at full build out). In addition, a number of other vehicle design features may also be desirable:

- **Shuttle buses.** While higher-capacity 40- or 60-foot buses are recommended for the longer term, lower-capacity 25- or 30-foot "cutaway" vehicles like those used for existing Caltrain shuttle service could continue to be used on an interim basis.
- **Larger buses.** Standard 40-foot coaches can accommodate the average peak load of 50 to 55 passengers, but in order to more comfortably accommodate larger "peak of the peak" loads, 60-foot articulated coaches might become necessary at some point. These vehicles would require longer stops.
- **Buses with low floors and boarding through multiple doors.** Low floors closer to the curb allow for "one-step" boarding and alighting. This is easier than climbing and descending stairs for passengers with mobility difficulties and/or mobility devices (including strollers and, if they are allowed on-board, bicycles in addition to wheelchairs and walkers), and it is faster for all passengers, as it speeds the loading and unloading process. This process is made even faster if passengers are allowed to board using all doors, using a proof-of-payment policy.
- **Alternative fuel vehicles.** Great strides have been made in recent years in "clean fuel" technology, ranging from hybrid diesel-electric models, buses powered by compressed natural gas (CNG), hydrogen fuel cells and biofuels. A particularly attractive option for Mountain View is a battery-powered electric model like those planned for the new Mountain View Community Shuttle and for Stanford University. However, alternative fuel buses can be more expensive not just to purchase, but to maintain.
- **Passenger amenities.** Finally, a number of customer service-oriented features may be desirable, including wireless internet service, high-capacity, rear-mounted bicycle racks, and real-time vehicle location data.

Alternative fuel transit vehicles would help to reduce emissions in the Shoreline Boulevard corridor.
Image from Flickr, Kecko

ESTIMATED COSTS

Costs to operate the service could vary greatly depending on a number of factors. The annual number of revenue hours[15] (a key driver and basic building block of transit operating and maintenance (O&M) costs)[16] required to operate the plan previously described can be estimated with some accuracy by estimating average speeds at different times and by making assumptions regarding span, frequency, and the amount of layover and recovery time required at the end of each trip. However, this estimate (Figure 6-10) should be viewed as one possible scenario, detailed in order to provide a sense of order-of-magnitude costs. Moreover, even if hours can be estimated with some accuracy, costs per hour can vary widely.

Based on a series of reasonable assumptions,[17] the annual number of revenue hours required to operate the baseline alternative has been estimated at approximately 36,300. At a cost of $75 per hour, a typical amount for privately contracted service, this would amount to an annual O&M cost of approximately $2.7 million; at $175 per hour, a typical rate for a publicly operated service, the cost would be $6.4 million.

15 "Revenue" hours are hours between the beginning and end of service spans; "platform" hours also include non-revenue or "deadhead" travel time between bus yards and terminals. Because deadhead typically accounts for a small fraction of platform time, revenue hours are generally used to calculate costs.

16 "Fully-allocated" cost per hour of revenue service is the unit cost most widely used in estimations of O&M costs. Fully-allocated cost is calculated by dividing total O&M costs by revenue hours, and as such, it accounts for both direct and indirect costs, including administrative costs.

17 Average speeds have been estimated at 15 miles per hour. During peak periods, it was assumed that operators would "hot-swap" or switch vehicles when taking breaks, allowing vehicles to remain in nearly continuous operation. During off-peak periods, layover and recovery time has been estimated at 15% of travel time.

FIGURE 6-10 ESTIMATED OPERATING COSTS

Day of Week	Rev Hrs	Days per Year	Annual Rev Hrs	At $75 / hour	At $175 / hour
Weekday	120	255	30,600	$2,295,000	$5,355,000
Weekend	52	110	5,720	$429,000	$1,001,000
TOTAL	**172**	**365**	**36,320**	**$2,724,000**	**$6,356,000**

Additionally, vehicles would need to be purchased, leased or provided by the operator of the service. Under the previously described scenario, the peak vehicle requirement would be 12 vehicles (plus two spares, for a total fleet of 14).

OPTIONS FOR SERVICE OPERATION

Operations might be managed using one of four basic administrative structures:

- Public agency
- Private company
- Nonprofit
- Joint Powers Authority (JPA)

Public Agency

The primary existing provider of public bus service in the area, VTA, could operate the service. This might take two forms:

- The service could be operated as part of the regular VTA network, with standard branding and fares.
- The service could be operated by VTA under contract, allowing for unique branding and fare-free operation.

There are advantages and disadvantages to each option. The first option would allow for greater integration of the local transit network. However, if VTA were to make service reductions in the future, the service could be subject to reduction or even elimination. Also, operating costs could be higher than contracted service.

The second option would allow for unique branding and fare-free operation, and might be less expensive. A similar arrangement exists in Oakland, where AC Transit operates the City of Oakland's free Broadway Shuttle service under contract, at a rate much lower than its fully allocated cost per hour of revenue service.

Private Company

Alternately, service could be administered by the City, the Mountain View TMA, or some other entity and operated under contract by a private-sector provider of transit service such as First Transit, MV Transportation, or Veolia Transportation. Operating costs may be lower than for VTA, even if operating the service under contract. This would be similar to the current arrangement, under which Caltrain shuttles are publicly funded but privately operated. The TMA is pursuing this approach for their initial shuttle service.

Nonprofit

Another organizational structure would divide responsibilities between the City, TMA, or other entity and a new nonprofit operator. This would be similar to

the existing configuration in Portland, Oregon, where the Portland Streetcar system is owned, managed, and partially funded by the City of Portland, which contracts out both construction and operation to the not-for-profit Portland Streetcar, Inc. The local transit agency, TriMet, provides both partial funding and staff, including operators and maintenance staff.

Joint Powers Authority (JPA)

Finally, administrative and funding duties could be shared by a JPA consisting of two or more governmental bodies, such as the City and VTA. JPAs are relatively common in the Bay Area: both Caltrain (the Peninsula Corridor Joint Powers Board) and the Capitol Corridor (the Capitol Corridor Joint Powers Authority) are overseen by JPAs. Both entities consist of elected boards that have contracted out day-to-day administration to transit operators (SamTrans and BART, respectively). Caltrain operation, formerly provided on a contract basis by Amtrak, is now provided by a private contractor (TransitAmerica Services Inc.), while the Capitol Corridor continues to be operated under contract by Amtrak.

OPERATING AND MAINTENANCE FACILITY

The vehicle storage and maintenance facility used would be dependent on the operating arrangement (see previous section, Options for Service Operation). Ideally, the facility would be located near the proposed route in order to reduce "deadhead" or non-revenue travel and cost. VTA's North Division is located near the proposed route, on La Avenida just east of Shoreline Boulevard and might be a potential site through an agreement with VTA.

If a new location were needed, the Mountain View TMA could work with participating employers to identify a joint site for both local and commuter shuttles, which are currently stored during the mid-day in the parking lot of Shoreline Amphitheater. The size of the site needed for such a shared facility would depend on programmatic requirements including fleet requirements as well as maintenance facilities.

Ultimately, a facility owned by the city or Mountain View TMA might be desirable, as it could help lower the cost of contracted service and provide the owner with flexibility to change service providers.

PHASING OPTIONS

Service Phasing

The proposed operating plan could be phased in a variety of ways. The simplest approach, however, would be to begin by implementing partial trunk ("Blue Line") service building on the Mountain View TMA's new MVGo West Bayshore route (which follows a similar alignment during peak periods), then increase service and add branch routes as needed. Additional coordination will be needed between the City and TMA depending on the implementation of the MVGo service and its performance.

Over time, more frequent mid-day, evening, and weekend service could be introduced, and branch (Red, Orange and Gold) routes could enter into service. It is recommended that no route operating on regular headways operate less frequently than every 15 minutes during peak periods, as travel times to North Bayshore itself would be 15 minutes or less.

Until the proposed stops on Central Expressway were implemented, Shoreline Boulevard service would need to continue to use the bus bays at the Transit Center, and would need to continue accessing the center via Villa Street, Franklin, and Evelyn Avenue, operating on those streets in both directions rather than via Middlefield Road and Moffett Boulevard.

MARKETING AND CUSTOMER INFORMATION

A key component of any successful transit system is an effective marketing plan. Marketing is crucial to raising public awareness of the transit system and ensuring adequate ridership growth. An effective marketing plan provides a single place for riders to obtain information about all services and a unified, consistent format for providing information to the public.

Information should be legible and integrated across a variety of platforms. Above all, it should enable riders to easily identify the service and navigate a trip, as well as facilitate a customer-friendly experience. The marketing plan should be closely coordinated with, and possibly led by, the newly formed TMA and integrated with existing marketing materials to the greatest extent possible. Key components of any marketing program include:

- **Branding:** Branding means creating an image for a product. The brand identity makes it easy to understand and recognize. This applies not only to consumer products but also to services like transit systems. For this service, a consistent branding is recommended to distinguish the service and increase its visibility. The branding would be applied to all aspects of the system, including: vehicles, stops, website, printed materials, etc. A first step would be to select a concise and memorable system name. A second step would be the development of a simple and identifiable logo and color scheme. Use of the new Mountain View TMA "MVgo" brand is recommended at this point.
- **Electronic Informational Tools:** A crucial component will be development of a smartphone application, which would allow passengers to access schedules, real-time information, and maps for the service. This app should be both corridor-specific and multimodal, providing information on all travel options in the corridor. The service should also have a strong web and social media presence. Key components include a stand-alone website, Facebook page, and Twitter handle. This information could be integrated with a future TMA website, the City's own website, 511, and Google transit.

The website for MVgo should evolve into a one-stop information center for travelers in the area.
Image from www.mvgo.org

- **Printed Materials:** A systemwide map is one of the most important tools for understanding how the routes work together to allow someone to travel from an origin to a destination. The routes and connections to other services should be readily identifiable. Maps could also be included as part of a system brochure that summarizes all aspects of the service. Printed materials should be available at all stops and distributed to major employers and trip generators in the corridor.
- **Bus Stops – Signage and Facilities:** Informative bus stops provide an invaluable ongoing marketing function. Comprehensive bus stop signs show people who are not familiar with the system that it exists and might be available to them. They also reassure riders that they are at the correct location to board a specific route, and system signs provide detailed schedule information. Adequate passenger amenities, such as lighting, signage, and shelters are also a crucial component to not just marketing, but passenger

The recently launched TMA (MVgo) offers a likely brand and identity for future shuttle services.

comfort. A good bus stop sign should be clear and should include the system name and logo. It should provide stop and frequency information, as well as a contact telephone number or website whenever possible.

- **Coordinated Marketing:** The primary objective for an information and advertising campaign should be to provide good public information. Closely coordinated and consistent marketing efforts are necessary to ensure ridership and communicate system changes. The TMA and City will need to collaborate to provide outreach to key groups, system changes or special projects, schedule changes, and respond to customer feedback.
- **Monitoring:** Knowing customer service issues that may arise can help staff to make service modifications or take other corrective actions as needed. The City and TMA must monitor its marketing and public information progress. By providing good customer service, transit users can call to describe poor experiences or other service problems.

The Marguerite shuttle system utilizes low-emission vehicles.

STANFORD MARGUERITE

Stanford University operates the Stanford Marguerite, a free shuttle system designed to help the meet the university's "no net new peak-hour trips" requirement for its general use permit. The service provides a key "last-mile" connection to regional transit with regular service to the Palo Alto and Menlo Park Caltrain stations. The Marguerite also provides fixed-route circulation within campus, to Downtown Palo Alto, the Stanford Medical Center, the Stanford Shopping Center, and California Avenue. From 2011 to 2012, the Marguerite had 1.8 million riders, or a daily average of approximately 5,000 riders.

The entire system has at least one shuttle running from 4:20 a.m. – 2:30 a.m., with the routes serving the medical center beginning at the earliest time and Lines N & O running nightly. Headways vary by route, with the Hoover Direct Express running every 10 minutes, and the Shopping Express running every 50 minutes.

On average, most routes have headways ranging from 15-30 minutes. All 23 routes on the system are free and open to the public.

The Marguerite provides key information at shuttle stops and has an extensive website detailing the system. A real-time shuttle map is available online and a smartphone app is also available. The app provides information on shuttle stops, schedules, and a real-time map of shuttles.

The service is funded by a variety of sources, including university parking revenue, grants from the Bay Area Air Quality Management District Transportation Fund for Clean Air and the Peninsula Corridor Joint Powers Board, and contributions from the Stanford Medical Center, Palo Alto Medical Foundation, the Stanford Shopping Center, and the Stanford Real Estate Office.

The Emery Go-Round Shuttle.
Image from Flickr, Paul Sullivan

EMERY GO-ROUND

The Emery Go-Round provides a connection between the MacArthur BART station in Oakland and major employment and retail centers in Emeryville. The Emery Go-Round is free of charge and available to the general public. Service was initially administered by the City of Emeryville in 1997 and was paid for through a public/private partnership. The shuttle evolved over the years and is now administered by the Emeryville Transportation Management Association (TMA), a non-profit organization whose purpose is to increase access and mobility to and from Emeryville businesses. Annual ridership is approximately 1.5 million trips.

The service schedule has expanded its hours of operation and frequency has gradually increased in the past several years. Weekday service runs from 5:45 a.m. to 10:00 p.m., Saturday service is operated from 9:30 a.m. to 9:30 p.m. and Sunday service is available from 10:30 a.m. to 6:00 p.m. Headways range from 12 minutes during weekday peak hours to 45 minutes on weekends. During the peak hour ten buses are in operation. The service has a dedicated website and real-time arrivals/departures are available via NextBus.

The TMA and the shuttle service are currently funded through a property-based business improvement district (PBID), with all commercial and industrial property owners in the city paying a fee to support the TMA and shuttle services. Operating expenses in 2014 were approximately $2.4 million. This cost covers day-to-day operations, administration and marketing. Operating revenue for 2014 was budgeted at $2.9 million. Assessment rates in 2008 were calculated by land use type:

- Commercial/Retail Use: $0.21 per square foot per year
- Industrial Use: $0.10 per square foot per year
- Residential (For Rent): $105 per unit per year

In July 2014, the City Council approved a 2.5% increase in the PBID assessment.

The City of Oakland's Broadway Shuttle.
Image from Flickr, Paul Sullivan

OAKLAND BROADWAY SHUTTLE

Introduced in 2010, the City of Oakland Broadway Shuttle is a transit service linking Jack London Square, Old Oakland, Chinatown, City Center, Uptown, and Lake Merritt along the Broadway corridor from Embarcadero to Grand Avenue. It provides a crucial "last-mile" connection to/from BART and Amtrak. The Oakland Broadway Shuttle consists of one shuttle route designed to serve shoppers and workers and is free to all passengers.

The Shuttle operates on a fixed route from 7:00 a.m. – 7:00 p.m. on weekdays, with headways ranging between 10-15 minutes. A new route was recently introduced for weekend nights, on Fridays from 7:00 p.m. – 1:00 a.m. and Saturdays from 6:00 p.m. – 1:00 a.m. Shuttle headways are every 12 minutes on weekend nights. Average weekday ridership is approximately 2,700[18] and has steadily increased since the service began. All vehicles are clean fuel.

The Broadway Shuttle was initially funded through a two-year $1 million grant from the Bay Area Air Quality Management District. BAAQMD has provided annual funding since then, with additional grants from public and private sponsors. These include the Oakland Redevelopment Agency, the developers of Jack London Square, Downtown Oakland Association, Lake Merritt-Uptown Association, The Uptown Apartments, and the Water Emergency Transportation Authority (WETA). The total budget is approximately $730,000, not including staff time.

18 http://www.sfgate.com/bayarea/article/Oakland-transit-developers-could-go-streetcar-5867528.php

LONG-TERM SERVICE EVOLUTION

The transit system recommended for Mountain View for the year 2030 would provide high capacity -- more than 1,000 passengers per hour each way -- but at relatively high operating cost, as the vehicles themselves would be moderate-capacity, and each vehicle would require an operator, resulting in significant labor costs.

As demand and usage grow, additional capacity could be provided with more and larger buses. At some point, however, a different, higher capacity system may be needed. Even with a transit-only lane in part of the corridor, transit priority at traffic signals, and measures to standardize dwell time, delays could still occur from closely-spaced buses. A primary concern is likely to be the increased operations cost.

If additional capacity were required, and/or if funding were to become available for a significant one-time capital investment, then a number of options would be available. Some medium to high-capacity modes are discussed.

FUTURE OPTIONS

Light Rail Transit

One option for increased transit capacity to North Bayshore would be an extension of the existing VTA light rail line terminating at the Mountain View Transit Center. In addition to increasing capacity between Downtown Mountain View and North Bayshore, this would connect North Bayshore directly to the rest of the VTA light rail system, with lines extending throughout Santa Clara County. The Mountain View line could be extended:

- **Primarily at-grade, in the median of Shoreline Boulevard.** Light rail would be moderately high in cost, perhaps in the range of $100 million per mile,[19] and would require significantly more right-of-way than the proposed reversible transit lane—the light rail right-of-way on Java Drive in Sunnyvale is approximately 29 feet wide at minimum. Additionally, a flyover of Central Expressway, ramps connecting Central to Shoreline Boulevard, and northbound lanes of Shoreline Boulevard would be required.
- **The project would also require almost entirely new construction of the corridor, as very few elements of the bus-based transitway could be used without major modifications.** Moreover, at-grade construction, while lowering cost, reduces speed and capacity, as vehicles must stop at signalized intersections and cannot operate faster than the posted speed limit.

19 San Francisco's Third Street Light Rail project, completed in 2007, primarily consists of double-tracked light rail in the median of an arterial street, is 5.4 miles in length, and cost $648 million to construct.

VTA Light Rail service currently terminates at Mountain View. An extension to North Bayshore would be expensive, but would provide higher-capacity service.

- **To further reduce cost, single-track segments might be built, such as the current single-track segment now undergoing expansion to the east of the transit center.** This could be accomplished by converting the reversible bus lane. A single track would restrict capacity, but might still be sufficient. A single three-car VTA light rail train can accommodate approximately 700 passengers, so a system with peak headways of ten minutes would have a capacity of over 4,000 passengers per hour, several times greater than a bus-based system.
- **Primarily elevated.** A viaduct in the median or to one side of Shoreline Boulevard would likely increase costs by a factor of 2.0-2.5,[20] but could reduce both right-of-way requirements and traffic impacts while simultaneously allowing for faster travel times and increased capacity. The shadow, noise, aesthetic, and other impacts of viaducts on adjacent land uses, pedestrians and cyclists are significant, but may be limited on a wide right-of-way such as Shoreline Boulevard, especially if the guideway is in the roadway median. Station footprints would be larger due to vertical circulation requirements.

20 http://vbn.aau.dk/files/14076659/Comparison_of_Capital_Costs.pdfs

Personal Rapid Transit

Personal Rapid Transit (PRT), or "Automated Transit Network" (ATN) technology, is a driverless fixed-guideway transit mode allowing passengers to custom-select destinations and bypass intervening stops. The first prototype PRT system was developed in Morgantown, West Virginia several decades ago, but the technology is relatively complex and thus remains relatively rare and largely untested. Currently, there are only five systems in existence, four of which consist of a single line with only a few stations (the PRT system at London's Heathrow Airport has three branches). San Jose's Mineta Transportation Institute has recently released a comprehensive study of PRT's prospects for more widespread adoption.[21] It found that PRT:

- Does not yet have a commercial market
- Is further limited by a lack of credible suppliers
- Currently exists only in the form of "line shuttles"
- Nonetheless has potential as a high-capacity, environmentally-friendly transit mode

The study concluded that " more research, development, and validation are needed ... before complex, wide-area network implementations will occur and before planners, developers and transit professionals will take ATN seriously."

PRT in the Shoreline Boulevard corridor would likely take the form of a single line, and thus may be more feasible in the near term. The technology offers a number of theoretical advantages over light rail and other more traditional modes, including:

- **Potentially lower capital costs.** While PRT requires grade-separation, its vehicles are small and its infrastructure is relatively lightweight. Cost information for existing projects is limited, but it is anticipated that costs would be less than $100 million per mile. The system may need more mileage to serve the primary destinations.
- **Reduced space requirements and impacts.** Elevated PRT systems have a smaller footprint than elevated light rail systems.
- **Very high frequencies.** While theoretical frequencies are even greater, current technology allows for headways as low as three seconds.

PRT has limited application thus far, but can potentially offer a high-capacity option. Heathrow airport in London and West Virginia University are two existing systems.

Images from (top down) Flickr, Gary Bembridge; Flickr Lukemn; Flicker, Jeremy T. Hetzel

While "personal" PRT vehicles have only a few seats, the extreme frequency at which they can operate allows for high system capacity –two-person vehicles operating every three seconds could carry up to 2,400 passengers per hour. The capacity of all five existing systems, however, is limited by the number of vehicles they operate. One major consideration is the required footprint at the Transit Center and aesthetic impacts to the downtown. One alternative would be to operate larger "Group Rapid Transit" (GRT) vehicles, which operate similarly to PRT but with higher capacity.

Use of PRT technology would offer one additional benefit over light rail. Because PRT stations are smaller and can be bypassed, more of them could be built, rather than the one or two that would be likely be built in North Bayshore if light rail were implemented.

Driverless Buses

As the headquarters of Google, Mountain View is the global capital of research into so-called "robocar" technology. Autonomous automobiles could greatly expand the capacity of existing roadways by allowing vehicles to safely operate much closer together. By the same token, use of driverless buses could increase the capacity of the planned reversible transit-only lane by allowing buses to operate much more frequently at lower cost. Google staff members have indicated that such technology may be only 10 or 20 years from widespread adoption. Guideways similar to those envisioned for a PRT system could also potentially be used by driverless cars or buses.

21 Available at http://transweb.sjsu.edu/project/1227.html

CHAPTER 7

IMPLEMENTATION PROGRAM

This study proposes a transformational package of improvements to reshape how Shoreline Boulevard and the larger street network connect North Bayshore to downtown. To achieve the vision outlined in this study, the City and its local and regional partners will need to develop a strategic implementation program that leverages existing and future development and funding opportunities. This chapter provides a summary of the estimated costs of the proposed improvements, a phasing plan, and a summary of potential funding sources.

COST ESTIMATES

The estimated costs for the proposed package of improvements are summarized in Figure 7-1. It should be emphasized that the cost figures are "planning-level" estimates. The costs provide an order-of-magnitude estimate for the City to utilize as it moves forward to secure financing and pursue grant opportunities. As concepts move to more detailed design and engineering, more precise costs will need to be developed.

The estimated cost for all proposed improvements is approximately $41 million, including the initial phase of the median transit lane (Figure 7-1). The cost estimates do not include right-of-way acquisition, but do include contingencies for project design and engineering, city administration, utilities, construction support, right-of-way evaluation, and other minor items. The cost estimates assume that an initial phase of the transit lane (estimated at $4.95 million) would be developed without landscaping buffers or median transit stops at Terra Bella Avenue and Pear Avenue. Appendix A includes a more detailed breakdown of cost estimates.

FIGURE 7-1 SUMMARY OF ESTIMATED PROJECT COSTS

Project Segment	Estimated Cost (2014 Dollars)
Transit Center Short-term Improvements	$326,000
Central Expressway/Moffett Boulevard/Castro Street Intersection	$1,630,000
Stierlin Road: Bike Lanes + Traffic Calming Elements	$1,200,000
Shoreline Boulevard: Stierlin/Montecito to Middlefield Road	$6,120,000
Shoreline Boulevard/Middlefield Road Intersection	$1,730,000
Shoreline Boulevard: Middlefield Road to Caltrans Right-of-Way	$6,440,000
Improvements in Caltrans Right-of-Way	
Bicycle/Pedestrian Bridge	$13,530,000
Other Improvements	$2,550,000
Median Bus Lane (Initial Phase)	$2,280,000
Median Bus Lane (Initial Phase outside Caltrans Right-of-Way)	$2,670,000
Shoreline Boulevard (b/t Bicycle/Pedestrian Bridge and Plymouth Street/Space Park Way)*	$2,610,000
TOTAL	$41,086,000

* Cost estimates for these and other improvements located further north along the corridor are included in the North Bayshore Precise Plan transportation improvement program.

PHASED IMPLEMENTATION PLAN

Full implementation of the complete package of corridor improvements will take time. Designs need to be further refined and developed, and several issues require additional study. Implementation of all capital facilities may require a commitment of additional funding, a process that could take several years. Nevertheless, the City has prioritized multimodal improvements to the Shoreline Boulevard corridor and seeks to implement various aspects of the recommendations as soon as possible. Therefore, a phased implementation plan is proposed. The phasing plan should be adjusted over time as conditions evolve and funding becomes available.

Full implementation of the complete package of corridor improvements will take time, yet the City seeks to implement various aspects of the recommendations as soon as possible.

SHORT-TERM (0 TO 3 YEARS)

The short-term phase includes implementation of an initial phase of the proposed transit and bicycle improvements along Shoreline Boulevard. The initial phase of the transit lane (described in Chapter 4) would require removal of all or portions of the median on Shoreline Boulevard, restriping, and signage to delineate the transit lane. Stops would not be included, but transit signal priority would be required to ensure safe operation of the transit lane. A minimum level of separation, such as a mountable curb or flexible bollards, is also recommended. The initial phase proposes the removal of the on-ramp to State Route 85 from northbound Shoreline Boulevard.

Similarly, low-cost and interim improvements to the existing bicycle lanes in the corridor would be a short-term priority. These include restriping to widen the bicycle lanes along Shoreline Boulevard, and installation of pavement markings to improve safety and visibility, especially on the U.S. Route 101 overcrossing. Striped buffers and flexible bollards at key locations are also an option. Other interim improvements include striping and installation of temporary buffers for bicycle lanes on Middlefield Road to enhance the connections to the Permanente and Stevens Creek Trails.

Other short-term priorities include installation of protected intersection improvements at Shoreline Boulevard/Middlefield Road, implementation of bicycle lanes and traffic calming on Stierlin Road, and reconfiguration of the Stierlin Road slip lane. To maximize efficiencies, it is recommended that the bike lanes on Stierlin Road be implemented in conjunction with the completion of the 100 Moffett Boulevard development, particularly the installation of the pedestrian and bicycle paseo connection to Central Expressway. At the Transit Center, shuttle operational changes and multimodal access improvements could be implemented quickly.

The short-term changes to Central Expressway/Moffett Boulevard/Castro Street are also a high-priority, but will require additional collaboration with Santa Clara County. Depending on transit demand and the evolution of the TMA and its public shuttle service, the initial phase of the transit service plan could also be implemented in the next three years. Finally, a comprehensive Transit Center Master Plan would also be completed within the next three years.

MEDIUM-TERM (3 TO 6 YEARS)

Beyond three years, full implementation of the median transit lane and the protected bicycle lanes (including the U.S. Route 101 bicycle/pedestrian bridge) would be the highest priority. This phase would include acquisition of the needed right-of-way and installation of the full landscaped buffers in the median and adjacent to the bicycle lanes. Expansion of the pedestrian realm and aesthetic improvements would also be included. Remaining protected intersection improvements along Shoreline Boulevard would also be implemented. Other medium-term projects include realignment of the freeway on-ramps and off-ramps to provide traffic calming benefits.

The most capital intensive infrastructure improvements would be included in this phase. Project development for these improvements, including environmental clearance, can begin in the near-term, but final design, funding, and construction will be a multiyear effort.

The complexity of the issues still to be answered in Caltrain corridor, particularly related to Caltrain mod-

ernization and future high-speed rail, mean that grade separation or significant changes to the station area would likely be a longer term project. These improvements would be developed as part of the Transit Center Master Plan.

The full transit service plan would not be phased in until all or portions of the North Bayshore development plan are implemented and demand justifies the proposed level of service.

FUNDING PROGRAM

To fully implement the proposed package of improvements a combination of local, regional, public, and private funding will be required. Summarized in this chapter are sources that could potentially be used to fund the proposed improvements. The City has discretion over a number of local sources of revenue and is engaged in ongoing negotiations with private developers and employers to secure additional community benefits.

FIGURE 7-2 SUMMARY OF PROJECT PHASING

Segment	Proposed Improvements	Short-term (0 to 3 years)	Medium-term (3 to 6 years)
Shoreline Boulevard	**Shoreline Boulevard - Transit Lane (Initial Phase).** Includes conversion of median and center lane between Middlefield Road and Plymouth Street or Space Park Way, pavement markings and striping, vertical/horizontal separation, transit priority signalization, and closure of access ramp to State Route-85 from northbound Shoreline Boulevard. Transit stops and full landscaped buffers would be deferred.	X	
	Shoreline Boulevard - Interim Bicycle Lane Enhancements (including U.S. Route 101 Overcrossing). Includes restriping to narrow travel lanes and widen bicycle lanes, plus pavement markings/signage at key locations. Options could also include a striped buffer and flexible bollards.	X	
	Shoreline Boulevard - Complete Protected Bicycle Lanes. Includes landscaped buffers, driveway treatments, pavements markings, and signage (Stierlin Road to Plymouth Street).		X
	Shoreline Boulevard - Complete Median Transit Lane. Includes landscaped buffers (Middlefield Road to Plymouth Street/Space Park Way) and transit stops at Terra Bella Avenue and Pear Avenue.		X
	Shoreline Boulevard/Middlefield Road Protected Intersection Improvements.	X	
	Shoreline Boulevard/Stierlin Road/Montecito Avenue Protected Intersection Improvements.		X
	Shoreline Boulevard/Terra Bella Avenue Intersection Improvements.		X
	Shoreline Boulevard. Additional marked pedestrian crossing (between Stierlin Road/Montecito Avenue and Middlefield Road) and pedestrian realm improvements (sidewalk widening, enhanced lighting, and streetscape elements).		X
Bicycle/Pedestrian Bridge	**Bicycle and Pedestrian Bridge.** Includes two-way protected bicycle lanes on west side of Shoreline Boulevard.		X
Middlefield Road	**Middlefield Road Bicycle Lane Enhancements.** Includes restriping to narrow travel lanes and widen bicycle lanes, and pavement markings/signage at key locations. Options could also include a striped buffer and/or physical separation.	X	
Stierlin Road	**Stierlin Road Slip Lane.** Includes vehicle travel lane, northbound protected bicycle lane, and driveway/crossing treatments.	X	
	Stierlin Road. Includes restriping to add bicycle lanes, narrow travel lanes, and installation of traffic calming measures.	X	
Central Expressway / Moffett Boulevard / Castro Street	**Castro Street/Moffett Boulevard/Central Expressway Intersection Improvements.** Includes reconfiguration of Castro Street approach plus signal timing changes, bike pavement markings, high-visibility crosswalks, and corner bulb-outs.	X	
Transit Center	**Transit Center Shuttle Management.** Includes enhanced management of bus center and new loading zones on Hope Street and/or View Street.	X	
	Transit Center Access Improvements. Includes new pedestrian access points, high-visibility crosswalks, additional bicycle parking and bicycle sharing pods, Kiss-n-Ride area improvements, car sharing, and passenger information.	X	
	Transit Center Master Plan. Includes long-term planning process to address station capacity, grade separation, additional bicycle and pedestrian access improvements, parking structure, and transit-oriented development.	X	
Transit Service	**Public Transit Service Plan (Initial).** Includes peak-period service and/or integration with short-term TMA service.	X	
	Public Transit Service Plan (Full). Includes all-day service.		X

At the regional level, the City will need to work with its partners to advocate for additional resources for transit, station area, and bicycle/pedestrian projects. A number of regional and state grant programs exist, but they are highly competitive. Given the innovative nature of the Shoreline Boulevard Corridor improvement plan, many elements may be well suited for these sources.

LOCAL SOURCES

Capital Improvement Program

The City of Mountain View adopts an annual Capital Improvement Program (CIP), which funds a wide variety of projects in order to maintain the City's significant investment in its infrastructure, comply with regulatory requirements, and address community needs through the expansion/enhancement of City infrastructure and facilities.

Multiple City funding sources will be required to support the implementation of the transportation-related improvements identified in this Study. These include the Shoreline Community Fund, a restricted funding source for the development and support of the Shoreline Community and surrounding North Bayshore area, and the City's CIP Reserve and Construction/Conveyance Tax Funds, both of which have no restrictions on how they can be used to fund capital projects.

City funding of the proposed package of improvements may also be augmented and/or replaced, wholly or in part, with funding from the other potential funding sources described below.

Developer Impact Fees

In recent years, communities throughout California have been increasingly relying on transportation-specific impact fees to ensure that the costs of transportation infrastructure and services necessary to support new development are fully financed. Development impact fees are a widely used, well-accepted practice in California because they offer one of the most efficient and effective ways to create a link between new development and the impacts it will have on the community.

Furthermore, transportation impact fees offer cities a revenue stream that can be used to fund a variety of transportation improvements which can help to mitigate or "offset" transportation impacts. By law, impact fees fall under the purview of the California Mitigation Fee Act and would require a nexus study. These fees cannot simply go to a city's general fund, but must be specifically allocated to transportation projects that address the specific impact.

Additional impact fees on future development in North Bayshore, along Shoreline Boulevard, or near the Transit Center present an opportunity to mitigate project impacts and fund desired mobility improvements.

Community Benefits/ Direct Provision of Improvements

In addition to impact fees, proposed development projects in North Bayshore are likely to directly construct some improvements and may agree to fund other projects through the city's community benefit provision.

Transportation Management Association

A non-profit Transportation Management Association (TMA) was formed in 2014 and currently includes a core group of major Mountain View employers and property owners, primarily in the North Bayshore area. The primary goal of the TMA is to pool resources to develop a coordinated set of strategies to better manage transportation and reduce single-occupancy vehicle trips. TMA members contribute funding to finance the programs.

The TMA is still in its initial stages of determining its priorities. It is likely that more companies and local businesses will join the TMA and its resources will grow. The TMA would not necessarily provide funding for capital improvements, but would be expected to operate shuttle services and other programs. Future collaboration between the City and TMA is needed to determine how TMA resources can best support the recommendations proposed in this study.

Transportation Development Act, Article 3

The Transportation Development Act (TDA), Article 3 designates Local Transportation Funds (derived from a quarter-cent state sales tax) for which cities and counties may utilize for planning and constructing pedestrian and bicycle facilities. The funding must be used for construction and/or engineering of bicycle or pedestrian projects; bicycle safety education programs; development of a comprehensive bicycle or pedestrian facilities plans; and restriping of Class II bicycle lanes.

The funds are administered by the Metropolitan Transportation Commission (MTC) and each city claims their annual allocation via an updated list of priority bicycle and pedestrian projects. Projects in the Shoreline Boulevard corridor would be included in the 2015 Bicycle Transportation Plan Update and prioritized for funding via that comprehensive document. In FY 2014-15, approximately $3.1 million of TDA, Article 3 revenues are available for Santa Clara County.[1]

1 http://www.mtc.ca.gov/funding/STA-TDA/Fund_Estimate_RES-4133_7-18-2014.pdf

REGIONAL AND STATE SOURCES/ GRANT PROGRAMS

Santa Clara County Measure A

Santa Clara County is a "self-help" county that taxes itself specifically for transportation purposes. The existing Measure A is a 30-year, half-cent sales tax that will run until 2036, and includes a number of transit improvement projects. However, the recent economic downturn has made it unlikely that all of the projects can be completed. As a result, discussions have begun to introduce an additional quarter-cent sales tax on the 2016 ballot. The measure would be for 30 years and is estimated to generate approximately $3.7 billion over the life of the tax. It is anticipated that a portion of the revenue would fund bicycle and pedestrian projects, as well as significant investments in the Caltrain corridor and at major transit stations. Some funding could also be allocated to Santa Clara County's Expressway system.

Vehicle Registration Fees - Surcharge for Bicycle Infrastructure

Senate Bill 1183 was passed in 2014 and allows a city, county, or regional park district to impose a vehicle registration surcharge to fund local bicycle infrastructure improvements and maintenance. The special tax may not exceed $5 per registration and requires a supermajority approval by voters. Revenues from the surcharge would be administered by the Department of Motor Vehicles and remitted to the local agency. The funds may be used for improvements to existing bicycle facilities or development of new facilities, as well as for related maintenance purposes. The law went into effect on January 1, 2015 and expires on January 1, 2025.

Caltrain Modernization Program

The Caltrain Modernization Program[2] is a $1.5 billion program that leverages local, regional, and federal funding to match $705 million in voter-approved high-speed rail bond revenues (2008 Proposition 1A). The program includes electrification of the system, installation of new advanced signaling and train control system, and replacement of existing diesel cars with electric trains. The program offers potential opportunities for enhancements at the Mountain View Transit Center, especially as it relates to safety and operational improvements along the tracks.

California Active Transportation Program

Senate Bill 99 and Assembly Bill 101 were signed into law in September 2013, creating the Active Transportation Program (ATP).[3] The program combined the Bicycle Transportation Account, Safe Routes to School program, and the Transportation Alternatives grant programs into one funding program. The funding is divided into three categories:

- 50% for the statewide competitive program
- 10% to the small urban and rural area competitive program
- 40% to the large urbanized area competitive program, distributed by the Metropolitan Planning Organizations (MTC in the Bay Area)

In Fiscal Year 2014-2015 and 2015-2016, the ATP authorized $180 million in statewide grants, with an additional $30 million available to MTC as part of its regional share. A locally adopted Complete Streets policy is a requirement to receive funding. In the Bay Area, regional dollars will be prioritized for projects that reduce collisions, increase active transportation, expand bike share programs, close bicycle network gaps, and improve access to schools.

Sustainable Transportation Planning Grant Program

The Sustainable Transportation Planning Grant Program[4] is administered by Caltrans in support of safe, sustainable, integrated transportation systems. Eligible projects include: complete streets, safe routes to school, bicycle and pedestrian projects, health equity transportation studies, traffic calming and enhancement projects, and transit plans. Caltrans authorized $8.3 million in funding for Fiscal Year 2015-2016. The minimum grant that will be awarded for Sustainable Communities is $50,000 and the maximum is $500,000. A local match is required.

OneBayArea Grant Program

Administered by MTC, the OneBayArea Grant Program (OBAG)[5] awards over $800 million in federal funds over a four-year period. The program goals include the integration of federal transportation programs with the region's Sustainable Communities Strategy (SCS). Jurisdictions that approve their Regional Housing Need Allocation (RHNA), support the SCS, and promote transit investments in Priority Development Areas (PDAs) receive additional priority in the funding distribution.

OBAG utilizes a distribution formula, in which population accounts for 50% of funding. The remaining 50% of funds are distributed based on housing needs and production. Santa Clara County was allocated $88 million in the second cycle of the grant program.

2 http://www.caltrain.com/projectsplans/CaltrainModernization/Modernization.html
3 http://www.dot.ca.gov/hq/LocalPrograms/atp/
4 http://www.dot.ca.gov/hq/tpp/grants.html
5 http://www.mtc.ca.gov/funding/onebayarea/

Transportation Fund for Clean Air

The Bay Area Air Quality Management District administers the Transportation Fund for Clean Air (TFCA),[6] with revenues from a $4 surcharge on vehicles registered in the Bay Area. The $22 million annual program awards projects that provide cost-effective means to decrease motor vehicle emissions. Funds are available via the Regional Fund (60% of funds) and the County Program Manager Fund (40%). Eligible projects include purchase of clean air vehicles; shuttle and feeder bus service to train stations; bicycle facility improvements; ride sharing programs; arterial management improvements; smart growth projects; and transit information programs. Any government agency is eligible to apply.

Cap-and-Trade Auction Revenue

The Global Warming Solutions Act of 2006 (AB 32) requires that California reduce greenhouse gas emissions to 1990 levels by 2020. One of the key programs designed to help meet that goal is a statewide cap-and-trade program.[7] Introduced in 2012, the cap-and-trade program works by first setting a limit on emissions, then allocating emissions amounts to emitters based on an auction process, and finally allowing emitters to buy and sell allowances. The auction is estimated to raise billions of dollars between 2012 and 2020. The latest statewide budget includes the first distribution of the auction revenue, approximately $850 million in Fiscal Year 2014-15.

The expenditure plan allocates revenue to programs that support Sustainable Communities Strategies (SB 375) and Clean Transportation programs. Of particular interest for Mountain View is the $100 million that will be allocated to grants that support Plan Bay Area.[8] While the grant program has yet to be developed, distribution of funding could be used to "…support transit capital and operating costs, bicycle facilities, development near transit stations, and other projects intended to reduce vehicle miles traveled."[9] Another $300 million will be used to support high-speed rail and modernization of intercity rail.

For future years, beginning in Fiscal Year 2015-16, 35% of the revenues would be continuously appropriated for Transportation, Affordable Housing, and Sustainable Communities programs (including 10% for the Transit and Intercity Rail Capital program). Another 25% is allocated to High Speed Rail and the remaining 40% is reserved for future programs.

6 http://www.baaqmd.gov/Divisions/Strategic-Incentives/Funding-Sources/TFCA.aspx
7 http://www.arb.ca.gov/cc/capandtrade/capandtrade.htm
8 http://onebayarea.org/plan-bay-area.html
9 http://www.lao.ca.gov/reports/2014/budget/cap-and-trade/auction-revenue-expenditure-022414.pdf