Berkeley SafeTREC

SAFE TRANSPORTATION RESEARCH AND EDUCATION CENTER

PS20022

CITY OF LAFAYETTE

COMPLETE STREETS SAFETY ASSESSMENT

Issues, Opportunities, and Suggested Strategies

Assessment Team

Afsaneh Yavari, T.E.
John Ciccarelli

November 2020

This report was produced in cooperation with the City of Lafayette. Funding for this program was provided by a grant from the California Office of Traffic Safety, through the National Highway Traffic Safety Administration. Opinions, findings, and conclusions are those of the authors and not necessarily those of the University of California and/or the agencies supporting or contributing to this report.

[page intentionally left blank]

CITY OF LAFAYETTE
COMPLETE STREETS SAFETY ASSESSMENT

FINAL REPORT

NOVEMBER 2020

ASSESSMENT TEAM

Afsaneh Yavari, T.E.
University of California Berkeley
SafeTREC / School of Public Health
2614 Dwight Way
Berkeley, CA 94720
(510) 642-2333
afsaneh.yavari@berkeley.edu

John Ciccarelli
Bicycle Solutions
511 Anderson St
San Francisco, CA 94110
(415) 912-6999
johnc@bicyclesolutions.com
www.bicyclesolutions.com

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

[page intentionally left blank]

EXECUTIVE SUMMARY

The City of Lafayette requested that SafeTREC at the University of California, Berkeley conduct a Complete Streets Safety Assessment (CSSA) study for various locations within the City. A team of two safety experts conducted the CSSA. One of the experts visited the City of Lafayette and conducted a walking audit on August 05, 2020. The objectives of the CSSA are to improve pedestrian and bicycle safety and to enhance walkability and accessibility for all pedestrians and bicyclists in Lafayette.

Based on 2017 California Office of Traffic Safety (OTS) data, Lafayette has a population of approximately 26,077 residents, which puts it in Group D, with 93 other California cities in the same population group. Based on the OTS Collision Rankings, Lafayette ranked 86 out of 94 for the number of pedestrian collisions, and 77 out of 94 for the number of bicyclists' collisions (with number 1 being the worst and 94 the best). This ranking is based on a number of weighted factors including population, daily vehicle miles traveled, collision records, collision trends, and others. For more information on OTS rankings, please refer to https://www.ots.ca.gov/media-and-research/crash-rankings-results/

This report is organized into the following chapters:

- Chapter 1 is an introduction to the Complete Streets Safety Assessment for City of Lafayette.
- Chapter 2 presents background information on bicyclist and pedestrian safety in the City and collision history.
- Chapter 3 presents benchmarking analysis results and suggestions for potential improvement from the benchmarking analysis.
- Chapter 4 presents field walking audit results and suggestions for potential improvements from the audit.

Benchmarking Analysis of Policies, Programs, and Practices

To assess pedestrian safety conditions in Lafayette, the expert team conducted a benchmarking analysis to understand how the City's existing conditions compared with current best practices. Through a pedestrian and bicycle safety assessment survey conducted with City staff, the expert team identified the City's pedestrian policies, programs, and practices and categorized them into three groups:

- Key strengths (areas where the City is exceeding national best practices)
- Enhancement areas (areas where the City is meeting best practices)
- Opportunity areas (areas where the City appears not to meet best practices)

While suggestions are provided for each category, cities have differing physical, demographic, and institutional characteristics that may make certain goals or policies more appropriate in some jurisdictions than others. Ultimately, City staff may determine where resources and efforts are best placed for meeting local development and infrastructure goals for pedestrians and bicyclists.

A discussion of the City's pedestrian and bicycle safety policies, programs, and practices, and suggestions for potential improvement or further enhancement to the City's existing programs and policies are presented in *Chapter 3*.

Walking Audit Focus Areas

Per City's request, the following three (3) locations were studied in this assessment:

1. Vicinity of Lafayette Elementary School and Stanley Middle School
2. Vicinity of Acalanes High School and Springhill Elementary School
3. Vicinity of Burton Valley Elementary School

Many of the strategies suggested in this report are appropriate for grant applications, including Office of Traffic Safety (OTS) or Active Transportation Program (ATP) funding. The strategies may also be incorporated into a bicycle or pedestrian master plan*,* documents that could set forth bicycle, pedestrian and streetscape policies for the City, identify, and prioritize capital improvement projects.

The suggestions presented in this report are based on limited field observations and time spent in Lafayette by the CSSA evaluator. These suggestions, which are based on general knowledge of best practices in pedestrian and bicycle design and safety, are intended to guide City staff in making decisions for future safety improvement projects in the City, and they may not incorporate all factors which may be relevant to safety issues in the City.

As this report is conceptual in nature, conditions may exist in the focus areas that were not observed and may not be compatible with suggestions in this report. Before finalizing and implementing any physical changes, City staff may choose to conduct more detailed studies or further analysis to refine or discard the suggestions in this report, if they are found to be contextually inappropriate or appear not to improve bicycling safety or accessibility due to conditions including, but not limited to, high vehicular traffic volume or speeds, physical limitations on space or sight distance, or other potential safety concerns.

1. INTRODUCTION

1.1. OBJECTIVE OF THE ASSESSMENT

The City of Lafayette (the City) requested that the Safe Transportation Research and Education Center (SafeTREC) at University of California, Berkeley conduct a Complete Streets Safety Assessment (CSSA) for the City. The objective of the CSSA is to improve safety and accessibility for all people walking and biking in the City of Lafayette. This assessment emphasizes safety and mobility issues associated with pedestrians and bicyclists.

1.2. ASSESSMENT APPROACH

The SafeTREC Safety experts conducted a pre-visit telephone interview with City staff on May 20, 2020. One of the SafeTREC experts met with City staff and conducted a walking audit at various locations in Lafayette on August 05, 2020. Positive practices, as well as pedestrian and bicycle safety and accessibility issues were identified at the field audit.

1.3. ACKNOWLEDGEMENTS

City of Lafayette staff member, Mr. Mike Moran, Director of Engineering and Public Works participated in the field visit and contributed to the wide range of topics addressed in this report. We would like to thank him.

1.4. DISCLOSURES

The benchmarking analysis aims to provide the City with information on current best practices and how the city compares. Cities have differing physical, demographic, and institutional characteristics that may make certain goals or policies more appropriate in some jurisdictions than others. Ultimately, City staff will determine where resources and efforts are best utilized to meet local development and infrastructure goals for people walking and biking.

The suggestions presented in this report are based on limited field observations and limited time spent in the City of Lafayette by the CSSA evaluator. These suggestions, which are based on general knowledge of best practices in pedestrian and bicycle design and safety, are intended to guide City staff in making decisions for future safety improvement projects in the city, and they may not incorporate all factors, which may be relevant to the pedestrian and bicycle safety issues in the city.

As this report is conceptual in nature, conditions may exist in the focus areas that were not observed and may not be compatible with suggestions in this report. Before finalizing and implementing any physical changes, City staff may conduct more detailed studies or further analysis to refine or discard the suggestions in this report if they are found to be contextually inappropriate or appear not to improve pedestrian and bicyclist safety or accessibility due to conditions including, but not limited to, high vehicular traffic volume or speeds, physical limitations on space or sight distance, or other potential safety concerns.

2. BACKGROUND AND COLLISION HISTORY

The City of Lafayette is located in Contra Costa County. Per Office of Traffic Safety, as of 2017, with a population of approximately 26,077, it is categorized as one of the 94 cities in Group D, population 25,001-50,000 people, as shown in Table 2-1.

Table 2-1: Lafayette Summary Statistics

Year	County	Population	Population Group	Daily Vehicle Miles Traveled (VMT)
2017	Contra Costa	26,077	D	260,097

Source: California Office of Traffic Safety, https://www.ots.ca.gov/media-and-research/collision-rankings/

2.1 PEDESTRIAN AND BICYCLISTS SAFETY OVERVIEW

The Office of Traffic Safety (OTS) collision rankings facilitate funding decisions and identify emerging traffic safety problem areas. The rankings allow cities to compare themselves to other cities with similar-sized populations and help them identify potential disproportionate traffic safety issues. OTS rankings are indicators of historical collisions; there are many factors that affect collisions in a city.

Victim and collision data for the rankings were acquired from the California Highway Patrol (CHP) Statewide Integrated Traffic Records System (SWITRS), California Department of Transportation (Caltrans), California Department of Justice (DOJ), and the Department of Finance (DOF). Collision rankings are based on the Empirical Bayesian (EB) Ranking Method which gives weights to many different factors, such as population, daily vehicle miles traveled, collision records, and collision trends, among others.

The 2017 OTS safety rankings for Lafayette are shown in Table 2-2. Based on the OTS 2017 statistics, Lafayette ranked 92 out of 94 California cities in Group D, in total fatal and injury collisions (with a ranking of “1” being the worst and “94” the best). It ranked 86 for pedestrian collisions, and 77 for bicyclist collisions.

Table 2-2: Lafayette Traffic Collisions and Rankings 2017

Type of Collision	Victims Killed & Injured	OTS Ranking (of 94 cities)
Total Fatal and Injury	8	92
Alcohol Involved	0	91
Motorcycles	0	90
Pedestrians	2	86
Pedestrians < 15	0	64
Pedestrians 65+	0	71
Bicyclists	2	77
Bicyclists < 15	1	35

2.2 PEDESTRIAN AND BICYCLE COLLISION DATA

The collision data for Lafayette from January 2015 to the end of 2019 was taken from the SafeTREC Transportation Injury Mapping System (TIMS) database. During this five-year period, 344 collisions occurred in Lafayette, 3 of which were fatal. There were 8 collisions involving pedestrians and 12 involving bicyclists.

Pedestrian Collisions

Within the 5-year period analyzed from TIM's data, 8 collisions involved pedestrians, one of which was fatal. Of the 8 collisions, 5 involved pedestrian crossing in crosswalk at an intersection. Most collisions happened on Fridays. The following charts depict this data:

Chart 2.1: Number of Pedestrian Collisions by Collision Severity, Lafayette

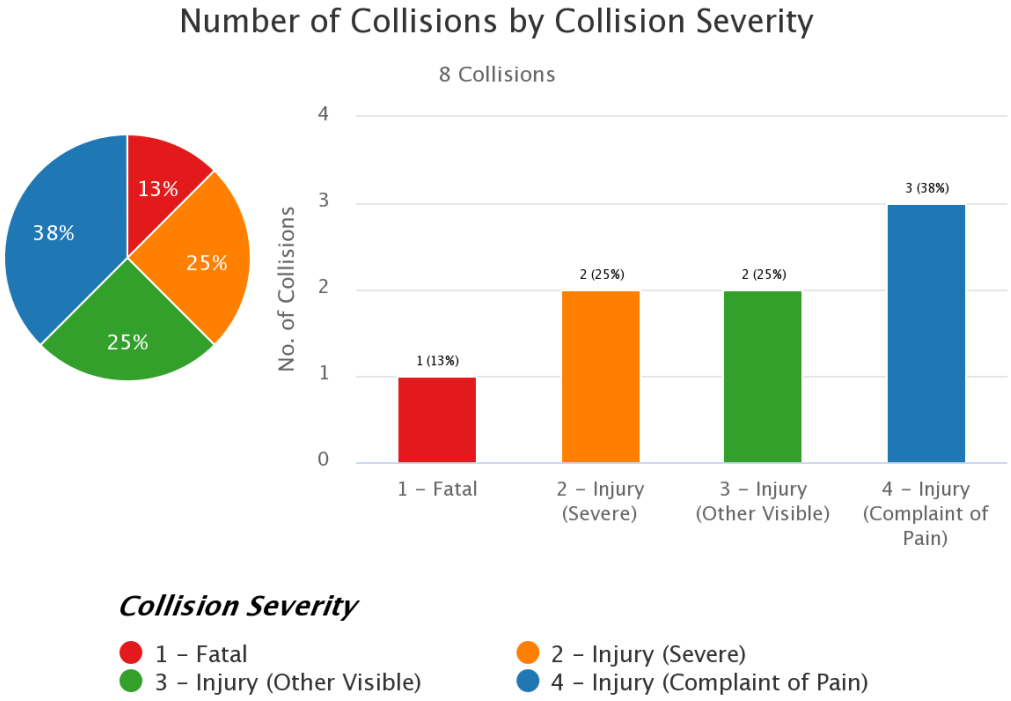


Chart 2.2: Number of Pedestrian Collisions per Day of Week per Time, Lafayette

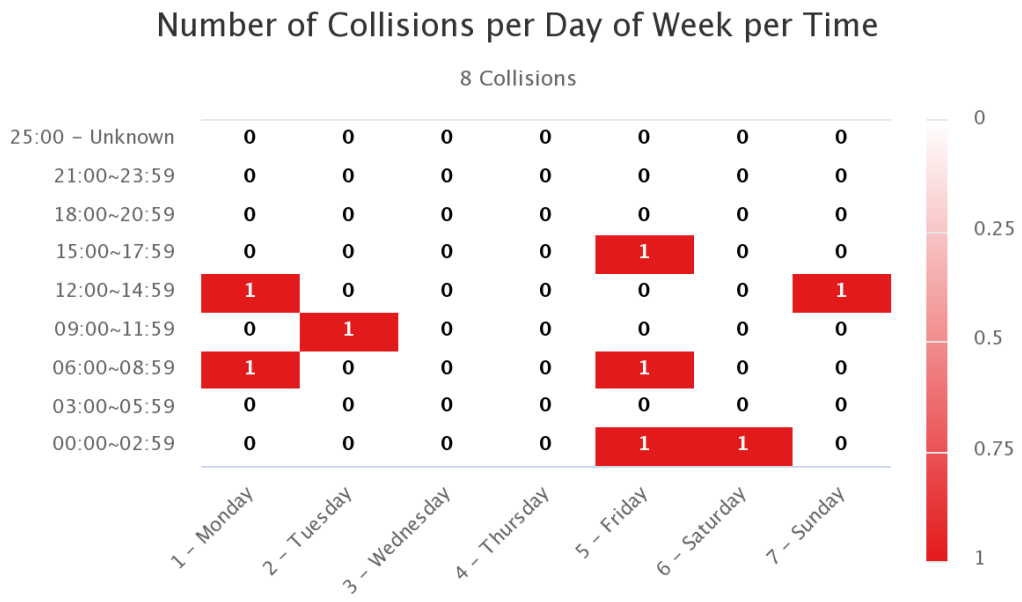
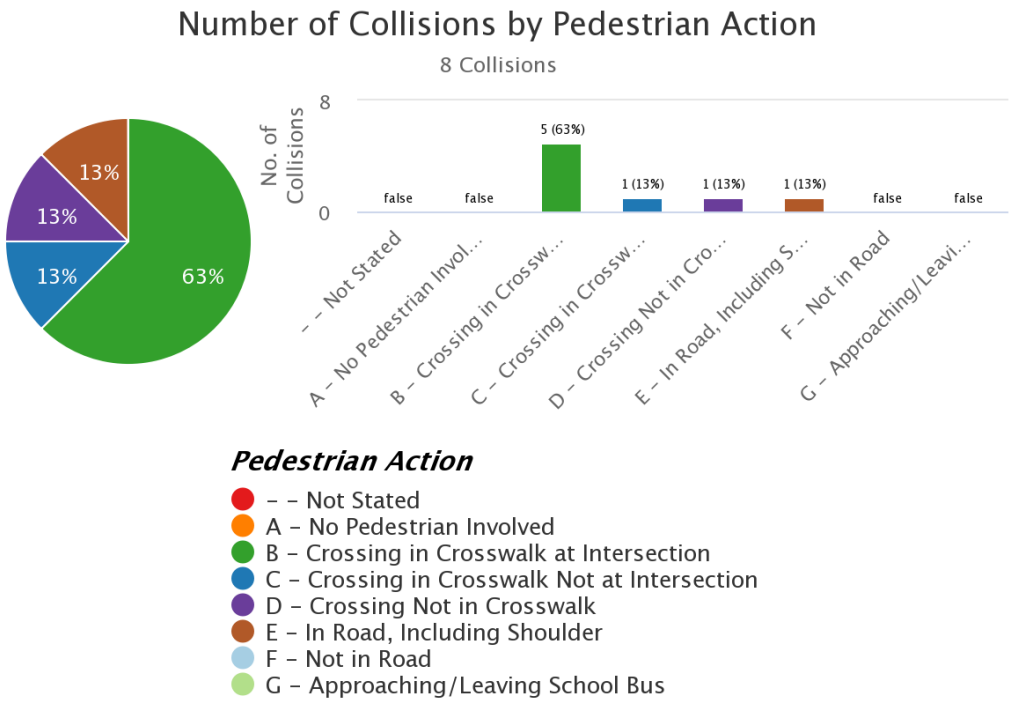


Chart 2.3: Number of Pedestrian Collisions by Pedestrian Action, Lafayette



Bicycle Collisions:

Based on the TIMS data, within the 5-year (2015-2019) period, there were 12 collisions involving bicyclists, one of which was fatal and one was with severe injury. A total of 4 collisions were caused due to the bicyclist riding on the wrong side of road. The highest number of collisions happened on Wednesdays and Fridays. The following charts depict this data.

Chart 2.4: Number of Bicycle Collisions by Collision Severity, Lafayette

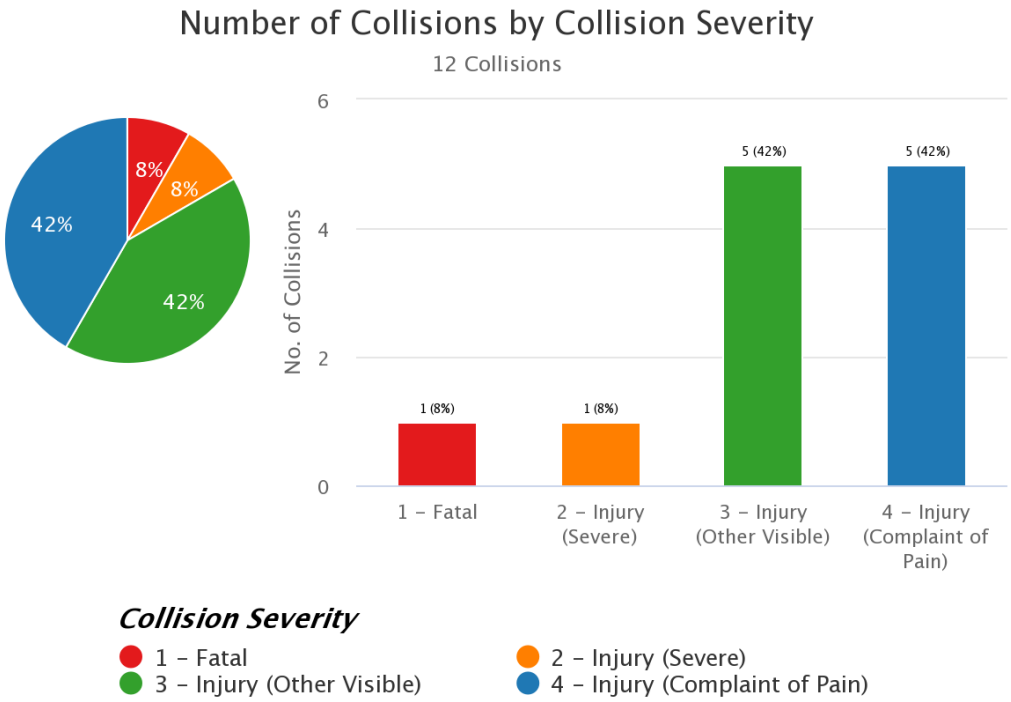


Chart 2.5: Number of Bicycle Collisions per Day of Week per Time, Lafayette

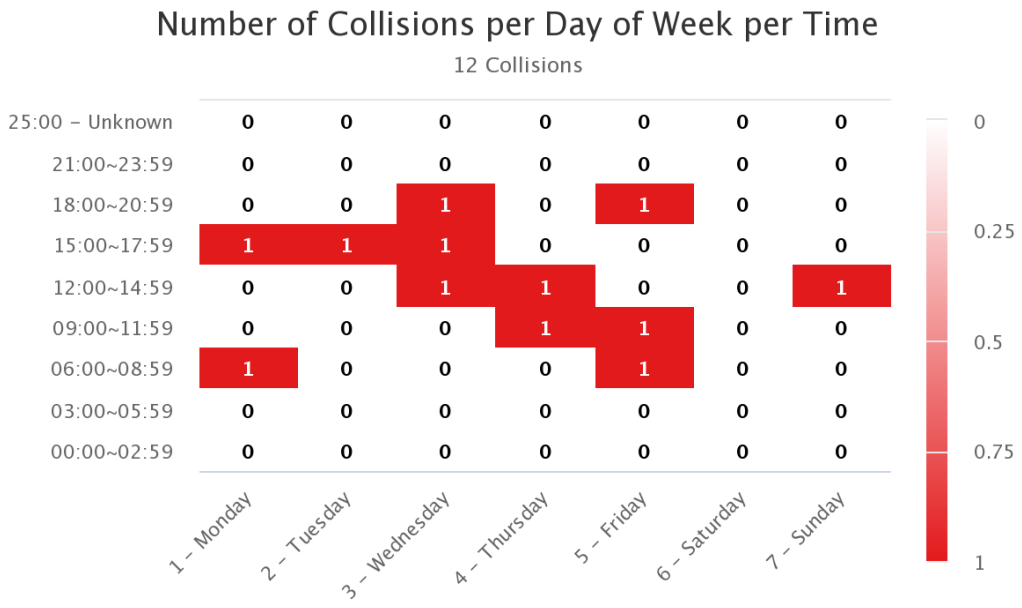
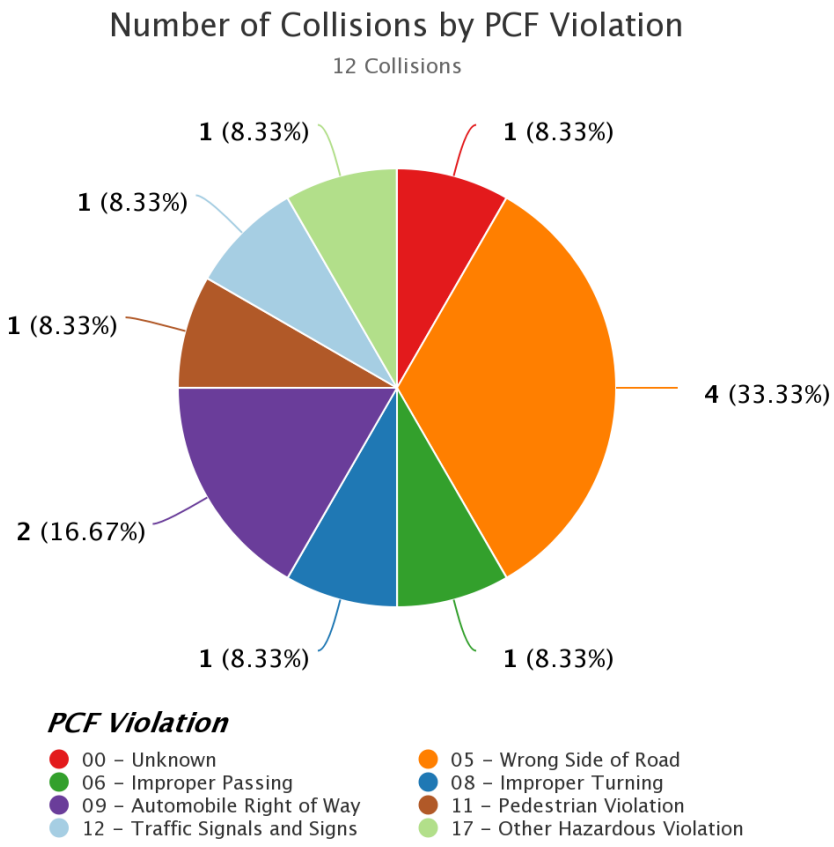


Chart 2.6: Number of Bicycle Collisions by Primary Collision Factor (PCF) Violation, Lafayette



The type of information provided above was obtained from SafeTREC's TIMS (https://tims.berkeley.edu/) can help the City Police Department in decision making in regards to their enforcement efforts.

2.3 STREET STORY

The Street Story program (https://streetstory.berkeley.edu/) is a relatively new tool developed by UC Berkeley's Safe Transportation Research and Education Center (SafeTREC) with OTS support. Street Story is a community engagement tool that allows residents, community groups and agencies to collect information about transportation collisions, near-misses, general hazards and safe locations to travel. To promote access to the tool, SafeTREC conducts technical assistance sessions with communities and organizations on using Street Story. Street Story is free to use and publicly accessible.

Street Story features a survey where people can record travel experiences. Once a record has been entered, the information is publicly accessible on the website with maps and tables that can be downloaded.

It is suggested that City staff use this free tool to collect information from their residents for local needs assessments, transportation safety planning efforts, safety programs and project proposals.

3. BENCHMARKING ANALYSIS RESULTS AND SUGGESTIONS

The City of Lafayette staff were asked to fill out a benchmarking matrix, as shown in Table 3-1 regarding the City's pedestrian and bicyclist safety policies, programs, and practices. Table 3-1 lists the benchmarking topics that fall under the following categories:

- Implementation of Americans with Disabilities Act (ADA) Improvements
- Policies and Programs
- Funding
- Data Collection
- Pedestrian and Bicycle Network Implementation
- Pedestrian and Bicycle Support Programs
- Others

The City's responses were analyzed, and its policies, programs, and practices were then compared with national best practices. This benchmarking analysis categorizes the results into three groups:

- Key Strengths (areas where the City is exceeding statewide best practices)
- Enhancement (areas where the City is meeting best practices)
- Opportunity (areas where the City appears not to meet best practices)

Each topic receives one of those three ratings and is highlighted in blue in the table below. This analysis shares information on current best practices and how the City compares. With differing physical, demographic, and institutional characteristics, certain goals or policies may be more appropriate in some jurisdictions than others may. Ultimately, City staff may determine where resources and efforts are best placed for meeting local development and infrastructure goals for pedestrians.

The items in Table 3-1 are further elaborated on in the following sections. The City may select strategies for implementation based on local priorities.

Table 3-1: City of Lafayette Programs, Policies, and Practices: Benchmarking Analysis

Benchmarking Topic	Key Strength	Enhancement	Opportunity
Implementation of Americans with Disabilities Act (ADA) Improvements			
Implementation of Americans with Disabilities Act (ADA) Improvements	Uses state-of-the-practice (PROWAG) ADA improvements with consistent installation practices	Has clear design guidelines but no regular practices for ADA compliance	Has minimal design guidelines and practices related to ADA requirements
ADA Transition Plan for Streets and Sidewalks	Has ADA transition plan in place and an ADA coordinator	Partial or outdated ADA transition plan or an ADA coordinator	No transition plan or ADA coordinator

Benchmarking Topic	Key Strength	Enhancement	Opportunity
Policies and Programs			
Pedestrian/Bicycle Coordinator	Has a Coordinator on staff who manages the agency's pedestrian and bicycle programs	Occasionally uses a part-time contract coordinator	Does not have a pedestrian/bicycle coordinator
Formal Advisory Committee	Has a formal, active Transportation Advisory Committee that address bicycle/pedestrian issues	Has an ad-hoc Transportation Advisory Committee	Does not have a Transportation Advisory Committee
Public Involvement and Feedback Process	Creates opportunities for public engagement on walking and biking topics on a regular basis, through a variety of community-specific formats (e.g., venues, times of day, languages)	Has a web-enabled public feedback process (e.g., 311 app) or includes formal public engagement in active transportation on a project-by-project basis	Does not have a formal public involvement or feedback process for bicycle/pedestrian planning or safety
Traffic Calming Program	Has a significant traffic calming program with a dedicated funding source	Has a traffic calming program but no dedicated funding source	Does not have a traffic calming program, or the program only includes speed humps
Speed Limits and Speed Surveys	Employs comprehensive practice to proactively review speed limits such as USLIMITS2. Considers traffic calming before raising speed limits in pedestrian or bicycle zones	Reviews data only in response to reported concerns or frequent collisions	Does not have set practices for speed limit reviews
Safe Routes to Schools	Has an ongoing Safe Routes to Schools program and funding for recent projects.	Has obtained funding for recent projects, but has no communitywide Safe Routes to Schools program	Does not have a Safe Routes to Schools program and has not obtained recent funding
Crosswalk Installation, Removal, and Enhancement Policies	Has a crosswalk policy that reflects best practices for signalized and uncontrolled crosswalk treatments (FHWA Field Guide), including consideration of Pedestrian Hybrid Beacons	Has no policy, but has an established crosswalk installation, removal, and enhancement practice in place	Does not have a policy or set practices for addressing crosswalk installation, removal, or enhancement
Shared Mobility Services	Has curbside management, shared mobility, or micromobility policies (e.g., permitting, enforcement) in place that prioritize pedestrian and bicyclist safety	Has curbside management, shared mobility, or micromobility policies in place, but without a focus on safety	No curbside management, shared mobility, or micromobility policies in place

Benchmarking Topic	Key Strength	Enhancement	Opportunity
Funding			
Funding	Has a dedicated annual funding stream for pedestrian and bicycle projects and local grant matches	Depends on grant funding for projects, and is successful in obtaining grants	Only moderately successful in obtaining grant funding or has trouble spending funds when given grants
Data Collection			
Collection of Pedestrian and Bicyclist Volumes	Collects pedestrian and bicyclist volumes routinely with intersection counts and has a GIS database of counts	Collects some pedestrian and bicyclist volumes, but not routinely	Does not collect pedestrian and bicycle volumes
Inventory of Bikeways, Parking, Informal Pathways, and Key Bicycle Opportunity Areas	Maintains an inventory of missing and existing bikeways in GIS and includes bikeway projects in the CIP	Maintains an inventory of missing facilities and opportunity areas	Does not have an inventory of missing/existing bikeways, parking, informal pathways, or key bicycle areas
Inventory of Sidewalks, Informal Pathways, and Key Pedestrian Opportunity Areas	Maintains an inventory of missing and existing sidewalks in GIS and includes sidewalk projects in the CIP	Maintains an inventory of missing sidewalks, informal pathways, or pedestrian opportunity areas	Does not have an inventory of missing sidewalks, informal pathways, or pedestrian opportunity areas
Pedestrian and Bicycle Traffic Control Audit (Signs, Markings, and Signals)	Maintains an inventory of pedestrian and bicycle signs, markings, and signals in GIS	Has a limited inventory of signs, markings, and signals	Does not have an inventory of signs, markings, and signals
Collision History and Collision Reporting Practices	Employs a data-driven systemic safety or Vision Zero approach to regularly analyze collision data citywide	Reviews data only following fatalities or other high-profile incidents	Does not have set practices for data review
Pedestrian and Bicycle Network Implementation			
Complete Streets Policy	Has a Complete Streets policy that includes all users and modes, affects new construction and maintenance, considers local context, and provides guidance for implementation	Has a Complete Streets policy that is narrow in scope or applies only to public works projects	Does not have a Complete Streets policy
Active Transportation Plans	Has a recently-updated Active Transportation Plan (or similar) with strategic prioritized list of projects that reflects current best practices (e.g., Level of Traffic Stress analysis, inclusion of Class IV protected bicycle facilities)	Has a Pedestrian or Bicycle Master Plan but it may be outdated and/or no recent projects from the Plan have been completed	Does not have a Pedestrian or Bicycle Master Plan

Benchmarking Topic	Key Strength	Enhancement	Opportunity
Existing bike network	Includes current best practice features such as cycle tracks, bicycle boulevards, intersection treatments, and/or buffered bike lanes	Includes Class I, II, and III only	Includes only bicycle routes or no designation
Existing pedestrian facilities	Includes current best practice ADA and safety features such as high visibility crosswalks and advance stop bars, PHBs or RRFBs, bulbouts, etc.	Narrow sidewalks or sidewalk gaps, crosswalks with few or no safety enhancements, with some pedestrian countdown signals	Missing key marked crosswalks and sidewalks, with few ADA improvements and no safety enhancements, and no pedestrian countdown signals
Bike Network Implementation Practices	Age 8 to 80 bicyclist considerations are applied and/or level of traffic stress is considered	Some traffic calming measures are implemented in conjunction with bikeway installation	Treatments are implemented where they fit within the right-of-way and vehicle LOS is not affected
Design guidelines and standards	Uses national best practices focused on bicycle and pedestrian safety for roadway and facility design guidelines and standards	Local standards reference national best practices, but are static or out of date, with minimal customized design policies for pedestrian and bicycle accommodations	Does not have a comprehensive design guidelines or standards for pedestrian or bicyclist treatments
Roadway Surfaces	Roadway resurfacing projects and debris removal are prioritized for bicycle routes.	Roadway surface is acceptable on bicycle routes and routine maintenance, including debris removal, occurs.	Roadway surface conditions are poor on some bicycle facilities and maintenance is not prioritized for bicycle facilities
Attention to Bicycle Crossing Barriers	Colored bike lanes and other innovative treatments, including geometric enhancements, are provided at intersections and interchanges	Bike treatments are installed at some intersections and interchanges	Bike treatments are not installed at intersections or through interchanges
Attention to Pedestrian Crossing Barriers	Has a recently updated policy and comprehensive inventory of barriers. Has design guidelines for addressing barriers	Has no policy, but has identified some barriers and taken steps to improve pedestrian access	Does not have a policy or practices for pedestrian crossings at railroads, freeways, and so on
Traffic Signal and Stop Sign Warrants	Uses relaxed warrants for traffic signals and/or all-way stops	Uses relaxed warrants for traffic signals or all-way stops	Uses MUTCD Warrants
Sidewalk furniture or other sidewalk zone policies	Design standards require implementation of the sidewalk zone system citywide. Does not allow apron parking or attached (unbuffered) sidewalks anywhere in the city.	Design standards require implementation of the sidewalk zone system in some districts (e.g., CBD, neighborhood commercial, etc.).	There are no design standards requiring implementation of the sidewalk zone system.

Benchmarking Topic	Key Strength	Enhancement	Opportunity
Pedestrian and Bicycle Support Program			
Street Tree Requirements	Has a street tree ordinance that improves pedestrian safety and access	Has a street tree ordinance, but it does not improve pedestrian safety or access	Does not have a street tree ordinance
Bicycling Supportive Amenities and Wayfinding	Bicycle supportive amenities (parking, routing/wayfinding, water fountains, repair stations) are found communitywide	Some bicycle supportive amenities are found in key areas	Bicyclist supportive amenities are not provided in the community
Bicycle Parking Requirements	A bicycle parking ordinance is enforced for all development and a program is in place to install and maintain public bike parking in existing development	A bicycle ordinance for off-street parking is in place but no requirement exists to install parking for existing development	No bike parking ordinance or program in place
Pedestrian and Bicycle Safety Education Program	Pedestrian and bicycle education programs are data-driven and focused on local safety context; education programs are customized for different groups	Has some traffic safety education programs that include pedestrians and bicyclists	Does not have pedestrian and bicycle safety education programs
Others			
Enforcement	Police Department conducts sustained and data-driven enforcement efforts focused on behavior and locations related to most severe bicycle and pedestrian crashes; enforcement activities are designed to consider equity implications	Police Department conducts some enforcement activities related to bicyclist and pedestrian safety	Police Department does not have Traffic Safety Officer(s)
Pedestrian Walking Audit Program	Has significant and ongoing programs that include regular walking audits	Has no safety program, but has conducted walking audits sporadically	Does not have a pedestrian safety program and has not conducted a walking audit
Bicycling Safety Audit Program	Has significant and ongoing programs which include bicycling audits	Has some programs and may have conducted a bicycling audit	Does not have bicycling safety audit programs

Benchmarking Topic	Key Strength	Enhancement	Opportunity
General Plan: Provision for Pedestrian and Bicycle Nodes	Pedestrian and bicycle nodes are identified and pedestrian-oriented policies are in place for these nodes	Pedestrian and bicycle nodes are identified, but pedestrian and bicycle accommodations are not	Pedestrian and bicycle nodes are not identified
Bike Ordinances (Sidewalk Riding)	Local ordinances allow for context-specific flexibility in sidewalk riding policies and enforcement (e.g., is there an adjacent bike facility?)	Local ordinance does not include section on sidewalk riding	Ordinances mandate that bikes are not allowed on sidewalks under any circumstances
Transportation Demand Management (TDM) Programs	Has a transit first policy, extensive TDM programs, and enforces parking cash out	Has basic voluntary TDM programs but does not provide reduced fee transit passes	Does not have a TDM program or policy
General Plan: Densities and Mixed Use Zones	Has moderate to high densities in the CBD and mixed-use zones and progressive parking policies, and transportation impact analysis for new development considers multi-modal trade-offs, rather than reliance on LOS	Has moderate densities with separate uses; transportation impact analysis relies on LOS	Has low densities with separate uses; transportation impact analysis relies on LOS
Specific Plans, Overlay Zones, and Other Area Plans	Bicyclist and pedestrian-oriented design, walkability, or placemaking is stressed in the plans	Plans require bicycle and pedestrian accommodations, and placemaking	Plans do not address bicyclist or pedestrian needs or do not exist
Historic Sites	Cultural and historic preservation plans include a wayfinding, bicycle, and walkability focus	Historic areas have been identified, and pedestrian and bicycle access is addressed	No plan is in place, and little consideration is given for pedestrian and bicycle access in historic areas
Economic Vitality	Has several business improvement districts, an established façade improvement program, and progressive downtown parking policies	Has a business improvement district, façade improvement program, or downtown parking policies	Does not have business improvement districts, a façade improvement program, or downtown parking policies
Proactive Approach to Institutional Coordination	Has identified obstacles and has implemented efforts to overcome barriers	Has identified obstacles	Does not have any identified obstacles
Coordination with Schools	Proactive coordination, including school siting for bikeability and walkability, occurs	Reactive coordination, to improve routes to schools, occurs	No coordination with schools regarding bicycle or pedestrian access occurs

Benchmarking Topic	Key Strength	Enhancement	Opportunity
Coordination with Emergency Response	Emergency response is involved in all aspects of bicycle/pedestrian facility planning and design (including pilot testing), and they balance response times with bicyclist/pedestrian safety	Emergency response is involved in some aspects of bicycle/pedestrian facility planning and design	Emergency response is not involved in bicycle/pedestrian facility planning and design
Coordination with Health Agencies	Coordinates regularly with health agencies in the planning of bicycle and pedestrian facilities and/or programs and collection of collision data	Health agencies have programs to promote healthy lifestyles through active transportation	Health agencies are not involved in bicycle/pedestrian safety or active transportation
Coordination with Transit Agencies	Bicycles are accommodated on all transit vehicles with overflow capacity available. There are safe and comfortable routes for biking and walking to transit stops and stations, including on roadways with both frequent bus service and bicycle facilities.	Bicycles are accommodated on buses only, with accommodation limited to rack capacity. Some transit stops and stations safe and comfortable routes for biking and walking access.	Bicycles are not accommodated on transit. There are few bicycle and pedestrian accommodations for accessing transit stops and stations.

KEY STRENGTHS

These are areas where the City is exceeding statewide best practices.

Formal Advisory Committee

Advisory committees serve as important sounding boards for new policies, programs, and practices. Responding to public concerns through public feedback mechanisms represents a more proactive and inclusive approach to bicycle and pedestrian safety compared with a conventional approach of reacting to collisions.

The City of Lafayette has a formal, active Transportation Advisory Committee that address bicycle/pedestrian issues.

Suggestion for Potential Improvement

- Consider establishing regular scheduled meetings to bring all transportation projects to the general committee to give opportunity for focused complete streets discussion.

Public Involvement and Feedback Process

Having multiple touch points with the community creates transparency and open lines of communication among the City, residents, and businesses. Different kinds of formats and venues for public involvement and feedback allows for broader participation from the community.

Consideration of local demographics (e.g., languages spoken) and the easiest formats for people to participate (e.g., online, in person but in the course of their daily activities, or at City-organized meetings) are important for meaningful and productive community dialogue.

The City of Lafayette creates opportunities for public engagement on walking and biking topics on a regular basis, through a variety of community-specific formats

Suggestions for Further Enhancement

- Provide notices and interpretation in the most commonly spoken languages in the City.
- As indicated in Section 2.3, consider using Street Story tool, which is a free tool to collect information from their residents for local needs assessments, transportation safety planning efforts, safety programs and project proposals. The Street Story tool (https://streetstory.berkeley.edu/) is developed by UC Berkeley's Safe Transportation Research and Education Center (SafeTREC) with OTS support. It is a community engagement tool that allows residents, community groups and agencies to collect information about transportation collisions, near-misses, general hazards and safe locations to travel. Street Story is publicly accessible. It features a survey where people can record their travel experiences.

General Plan: Densities and Mixed Use Zones

Planning principles contained in a city's General Plan can provide an important policy context for developing bicycle-oriented and walkable areas. Transit-oriented development, higher densities, and mixed uses are important planning tools for pedestrian-oriented areas.

The City has moderate to high densities in the CBD and mixed-use zones and progressive parking policies, and transportation impact analysis for new development considers multi-modal trade-offs, rather than reliance on LOS.

Suggestions for Further Enhancement

- Utilize vehicle miles traveled (VMT) for future transportation impact analysis.
- Ensure the existing and future priority pedestrian areas in the City, as identified in the ATP, are focus areas in future specific plans and the General Plan update, where varied densities and mixed-uses could accommodate or attract pedestrian activity.
- Consider allowing moderate to high densities in the downtown and mixed-use zones as well progressive parking policies, such as shared parking and demand-based pricing.
- Consider multi-modal trade-offs in the transportation impact analysis for new development, so that the safety and needs of people walking and biking is weighed heavily and vehicular delay is not the primary performance measure.

ENHANCEMENT

These are areas where the City is meeting best practices.

Implementation of Americans with Disabilities Act (ADA) Improvements

Implementation of ADA improvements is key to making walking accessible and safe for everyone, regardless of ability or age.

The City of Lafayette has clear design guidelines but no regular practices for ADA compliance. Most ADA updates are completed as part of a City Capital Improvement Project.

Suggestions for Further Enhancement

- Prioritize areas within the City that exhibit greatest pedestrian activity for ADA improvements
- Provide ADA standards and best practice training for engineering staff at all levels.
- Add ADA ramps at intersections that currently lack them and upgrade non-complaint ramps (replacing one ramp to two directional ramps at each corner).
- Consider prioritizing sub-areas within the City that exhibit greatest pedestrian activity.

Traffic Calming Program

Traffic calming programs and policies set forth a consensus threshold on neighborhood requests and approvals, as well as standard treatments and criteria.

Traffic calming improvements are initiated by neighborhoods in Lafayette.

Suggestions for Potential Improvement

- Expand the City's traffic calming toolbox to include other tools, such as raised crosswalks, raised intersections, chicanes, and traffic diverters.
- Expand the City's practices to include proactive traffic calming measures. The City could consider allocating a portion of funding to proactive traffic calming, such as bicycle boulevards or safe routes to schools, and then allocate the remaining funding to react to specific community requests.
- Refer to the following resources for traffic calming best practices:

  https://www.ite.org/technical-resources/traffic-calming/traffic-calming-measures/

  https://safety.fhwa.dot.gov/ped_bike/univcourse/pdf/swless11.pdf

Speed Limits and Speed Surveys

Local municipalities have the authority to set the posted speed limit based on current speed data. The speed limit is rounded to the nearest five mile per hour (MPH) increment based on the 85th percentile speed of free-flowing traffic. School zone speed limits in California are a de facto 25 miles per hour or less, where specified. Speed limits are also critical for complete streets safety.

Pedestrian fatality rates increase exponentially with vehicle speed. Thus, controlling vehicle speeds is one of the most important strategies for enhancing pedestrian and bicyclist safety.

The City reviews speed data only in response to reported concerns or frequent collisions.

Suggestions for Potential Improvement

- Install traffic calming measures, signal coordination, and similar tools to maintain slower speeds appropriate for an urban community, particularly on streets that will be reviewed in the next speed survey. Please refer to: https://www.transportation.gov/mission/health/Traffic-Calming-to-Slow-Vehicle-Speeds
- After complete streets improvements and other safety improvements are installed, conduct off-cycle speed surveys to review the speed limit and determine whether it needs to be reduced based on the improvements.
- Consider pedestrian volumes and known complete streets safety issues when setting speed limits and employ traffic calming strategies in locations where speed surveys suggest traffic speeds are too high for pedestrian and bicyclist safety.
- Ensure complete streets design standards have appropriate target design speeds for urban areas and do not contribute to a routine need for traffic calming.
- Consider the use of 15 MPH for school zones, as well as any area with a population of senior citizens.

Crosswalk Installation, Removal, and Enhancement Policies

A formal policy for crosswalk installation, removal, and enhancement provides transparency in decision-making and adopts best practices in pedestrian safety and accommodation. It includes consideration of all kinds of crosswalks, including uncontrolled and controlled locations.

Lafayette has no policy, but has an established crosswalk installation, removal, and enhancement practice in place.

Suggestions for Further Enhancement

- Develop a citywide crosswalk policy for installation, removal, and enhancement of crosswalks at controlled and uncontrolled intersections citywide. Ensure that it is consistent with best practices and recent research. This includes removing crosswalks only as a last resort. Consider providing midblock crossings where they serve pedestrian desire lines.
- Consider developing a treatment selection “tool” to assist staff with the identification of applicable treatments in a given context.
- When crosswalk enhancements are identified, consider adding them to a prioritized list that will be upgraded over time, as funding is available.

Crosswalk policy resources include:

- National Cooperative Highway Research Program Application of Pedestrian Crossing Treatments for Streets and Highways: http://www.trb.org/Publications/Blurbs/175419.aspx

Collection of Pedestrian and Bicyclist Volumes

Pedestrian and bicyclist volume data is important for understanding where people walk and bike. This establishes baseline data prior to project implementation and can help prioritize projects, develop collision rates, and determine appropriate bicycle and pedestrian infrastructure.

The City collects some pedestrian and bicyclist volumes, but not routinely.

Suggestions for Further Enhancement

- Routinely collect pedestrian and bicycle volumes.
- Geocode pedestrian and bicycle volume data with GIS software along with other data such as pedestrian and bicycle control devices and collisions to analyze data for trends or hotspots related to safety.

Inventory of Bikeways, Bike Parking, and Key Bicycle Opportunity Areas

A GIS-based bicycle infrastructure inventory enables project identification and prioritization, as well as project coordination with new development, roadway resurfacing, etc. This data set can be available on the City's website for knowledge sharing with the public as well as agencies.

The City of Lafayette maintains an inventory of missing facilities.

Suggestion for Further Enhancement

- Consider establishing a system of inventory of missing infrastructure for bicycle facilities.

Inventory of Sidewalks, Informal Pathways, and Key Pedestrian Opportunity Areas

A GIS-based sidewalk inventory enables project identification and prioritization, as well as project coordination with new development, roadway resurfacing, and so on.

The City maintains an inventory of missing sidewalks, informal pathways, or pedestrian opportunity areas.

Suggestions for Further Enhancement

- Create a citywide inventory of existing and missing sidewalks, informal pathways and key pedestrian opportunity areas in GIS.
- Consider establishing a program to work with property owners to repair damaged sidewalks outside their property. This can be a condition for the sale of the property.
- Geo-code the existing inventory of sidewalks in the City and add informal pathways and key pedestrian opportunity areas.

Pedestrian and Bicycle Traffic Control Audit (Signs, Markings, and Signals)

Cities have a wide variety of traffic control devices that regulate how bicyclist and pedestrians should use the street and interact safely with drivers. However, some cities do not have inventories how, when, and where these are installed. Creating a database of this information allows the City to know where infrastructure may be out of date or in needed of updates. For example, countdown signals are important pedestrian safety countermeasure. The California *Manual of Uniform Traffic Control Devices* (CAMUTCD) requires installation of countdown pedestrian signals for all new signals. It also requires installation of bike detection at all actuated signals. Bike detection is a basic building block of the bike network to make sure that bikes can trigger the traffic signal. Inventorying bike detection and countdown signals allows the City to approach safety from a systems perspective and develop projects to close gaps in biking and walking infrastructure over time.

The City has a limited inventory of signs, markings, and signals.

Suggestions for Potential Improvement

- Develop a citywide crosswalk inventory in GIS and maintain it over time. This would allow for a systemic safety approach to enhancing crosswalks, and allow the City to prioritize all crosswalk enhancement projects citywide for implementation over time and as money is available.
- Ensure that locations with pedestrian desire lines have safe crosswalks. An updated crosswalk policy can help determine the appropriate crossing treatment at uncontrolled locations without marked crosswalks.
- Include maintenance records within the GIS database inventory of signs, markings and signals.
- Develop a proactive monitoring program for ensuring the quality and proper functioning of traffic control devices.

Complete Streets Policy

A Complete Streets Policy includes all users and modes, affects new construction and maintenance, considers local context, and provides guidance for implementation. Complete Streets Policies are formal statements showing a City's commitment to planning and designing for all modes of travel and travelers of all ages and abilities.

City of Lafayette has a Complete Streets policy that is narrow in scope or applies only to public works projects.

Suggestion for Potential Improvement

- The following jurisdictions have established practices for complete streets, including implementation of these policies through multimodal level of service thresholds, and may serve as models for Lafayette:

Boston, Massachusetts, Boston's Complete Streets:
http://bostoncompletestreets.org/about/

Philadelphia, Pennsylvania, Philly Free Streets:
http://www.phillyfreestreets.com/

Baltimore, Maryland, Complete Streets Ordinance:
https://transportation.baltimorecity.gov/completestreets

South Bend, Indiana, Complete Streets Policy:
https://www.smartgrowthamerica.org/app/legacy/documents/cs/policy/cs-in-south-bend-resolution.pdf

Town of Ashland, Massachusetts, Complete Streets Policy:
https://www.smartgrowthamerica.org/app/legacy/documents/cs/policy/cs-ma-ashland-policy.pdf

Active Transportation Plans (ATP)

This type of plan includes a large menu of policy, program, and practice suggestions, as well as site-specific (and prototypical) engineering treatment suggestions. Bicycle and Pedestrian Master Plan(s) documents a jurisdiction's vision for improving walkability, bikeability, and bicycle and pedestrian safety; establish policies, programs, and practices; and outline the prioritization and budgeting process for project implementation.

The City has a Pedestrian or Bicycle Master Plan but it may be outdated and/or no recent projects from the Plan have been completed.

Suggestion for Potential Improvement

- Implement the "low-hanging-fruit" projects in the ATP and seek grant funding for major projects.
- Pursue additional funding opportunities for programs identified by the Plan.
- Provide regular updates to the Plan, including bicycle and pedestrian facilities and design guidelines that address the needs of bicyclists and pedestrians of all ages and abilities.

Existing bike network

Innovative features such as separated bikeways, bicycle boulevards, and buffered bike lanes can decrease the level of traffic stress experienced by bicyclists, make biking more comfortable, and —in so doing—appeal to a wide range of bicyclists. Level of traffic stress refers to the level of comfort or discomfort a bicyclist might experience. Research conducted by the Mineta Institute in San Jose establishes levels of traffic stress on a scale for 1 to 4 with LTS 1 at the level that most children can tolerate and LTS 4 at the level characterized by "strong and fearless" cyclists (see: http://transweb.sjsu.edu/project/1005.html). A bicycle network that is attractive to the majority of the population would have low stress and high connectivity.

The City's bike network includes Class I, II, and III only.

Suggestions for Further Enhancement:

- Continue to identify funding sources and implement the proposed projects identified in ATP.
- Develop design standards for bike boulevards, trails, paths, and landscaping for bicycle network.
- Create a GIS data for existing bike network to identify gaps and opportunities for improvements.

Existing Pedestrian Facilities

The pedestrian facilities include current best practice ADA and safety features such as high visibility crosswalks and advance stop bars, PHBs or RRFBs, bulbouts, etc.

The City of Lafayette's existing pedestrian facilities include narrow sidewalks or sidewalk gaps, crosswalks with few or no safety enhancements, with some pedestrian countdown signals.

Suggestions for Potential Improvement:

- Create a GIS database for existing pedestrian infrastructure to identify gaps, inventory assets, and create opportunities for systemic safety analysis of all sidewalks and crosswalks in the City.
- Identify funding sources for enhancement of sidewalks and crosswalks to include safety features and provide ADA compliance.

Design Guidelines and Standards

Design guidelines and development standards create a clear set of documents that guide how all transportation improvements could be installed citywide. As a result, they can create a consistent, high-quality biking and walking experience.

The City of Lafayette has local standards which reference national best practices, with minimal customized design policies for pedestrian and bicycle accommodations.

Suggestions for Further Enhancement

- Consider reviewing other useful design guidelines and standards:
  - NACTO Urban Street Design Guide: http://www.nyc.gov/html/dot/downloads/pdf/2012-nacto-urban-street-design-guide.pdf
  - FHWA Separated Bike Lane Planning and Design Guide https://nacto.org/wp-content/uploads/2016/05/2-4_FHWA-Separated-Bike-Lane-Guide-ch-5_2014.pdf
  - MassDOT Separated Bike Lane Planning & Design Guide https://www.mass.gov/lists/separated-bike-lane-planning-design-guide

- ITE Recommended Practice for Accommodating Pedestrians and Bicyclists at Interchanges https://www.fehrandpeers.com/bicycle-pedestrian-interchanges/

Roadway Surfaces

The quality of a roadway surface along bikeways is an important consideration when choosing to ride. Rough surface in a bike lane creates an uncomfortable bicycling experience and may pose safety hazards.

Roadway surface conditions are acceptable in Lafayette on bicycle routes, and routine maintenance, including debris removal, occurs.

Suggestion for Potential Improvement:

- Prioritize maintenance of roadways where bicycle facilities are present, particularly for closing gaps in the bikeway network or where improved pavement quality is needed on popular bicycle routes.
- Prioritize debris removal on roadways where bicycle facilities are present.

Attention to Bicycle and Pedestrian Crossing Barriers

Crossing barriers—such as railroads, freeways, and major arterials—may discourage or even prohibit bicycle access and are often associated with vehicle-bicycle collisions. Large intersections and interchanges and uncontrolled crossings can often deter bicyclists due to high speeds, high number of conflict points with vehicles, and high level of exposure. Identifying and removing barriers and preventing new barriers is essential for improving bicyclist safety and access. Crossing barriers also discourage or even prohibit pedestrian access and can create safety challenges for pedestrians. These can be similar to the biking barriers or present additional challenges.

The City of Lafayette has no policy, but has identified some barriers and taken steps to improve pedestrian access. Bike treatments are installed at some intersections and interchanges.

Suggestion for Further Enhancement

- Identify and create an inventory of bicycle crossing barriers, along with potential safety countermeasures.
- Identify additional existing “conflict zones” along bikeways—such as large intersection and driveways—and implement enhancements such as green pavement. See Oakland’s bicycle lane striping guidance for more information on green striping: http://www2.oaklandnet.com/oakca1/groups/pwa/documents/report/oak052468.pdf

- Coordinate with Caltrans to improve bicycle and pedestrian facilities at crossings, interchanges, and intersections with state highways to build out the District 4 Bicycle Master Plan, and implement best practice guidance on bicycle accommodation through interchanges and expressways, as appropriate, using the ITE's *Recommended Design Guidelines to Accommodate Pedestrians and Bicycles at Interchanges,* and *Recommended Design Guidelines to Accommodate Pedestrians and Bicycles at Interchanges: A Recommended Practice at the Institute of Transportation Engineers,* plus consideration of protected bicycle lane design.

- To slow speeds at critical intersections, use smaller corner radii using small design vehicles appropriate for urban areas and update standard to reflect this.

- Review design of slip/channelized right-turn lanes at intersections and implement improvements to slow speed and improve visibility.

- Evaluate upgrades to existing pedestrian and bicycle-only bridges over canals and feasibility of adding more bridges.

- Identify and create an inventory of pedestrian barriers with targeted suggestions for phased improvements.

- Consider pedestrian barriers and needs while conducting bicycle barriers assessment

Street Tree Requirements

Street trees enhance the pedestrian environment by providing shade and a buffer from vehicles, which increase pedestrian safety. Street trees may also enhance property values, especially in residential neighborhoods. However, street trees, when improperly selected, planted, or maintained, may cause damage to adjacent public utilities.

The City of Lafayette has a street tree ordinance, but it does not improve pedestrian safety or access.

Suggestion for Further Enhancement

- Update the Street Tree Ordinance to provide guidance on permissible tree types and permitting requirements, also specifying a requirement for new trees plantings associated with development projects.

Bicycling Supportive Amenities and Wayfinding

In addition to designating roadway or paths in a bicycle network, supportive amenities (including parking, water fountains, and maintenance stations) can encourage bicycling. Wayfinding can both encourage bicycling and enhance safety by navigating cyclists to facilities that have been enhanced for bicyclists' use or to local retail opportunities for economic growth.

Some bicycle supportive amenities are found in key areas in Lafayette.

Suggestions for Further Enhancement:

- Develop a pilot program for bicycle supportive amenities at key locations in the city, such as schools; include bicycle fix-it stations, water fountains, and similar amenities.
- Create and deploy a bicycle wayfinding strategy citywide.

Pedestrian and Bicycle Safety Education Program

Engineering treatments are often not enough on their own to realize full safety benefits associated with the treatment. Safety education programs complement engineering treatments and increase compliance. Education campaigns target people of all ages, especially school-age children where safe walking and biking habits may be instilled as lifelong lessons.

The City has some traffic safety education programs that include pedestrians and bicyclists.

Suggestion for Potential Improvement

- Consider conducting formal education campaign targeting people driving, walking, and biking about street safety. This includes advertisements on buses and bus shelters, an in-school curriculum, community school courses, public service announcements, and many other strategies. Consider a focus on speed and safe driving.

The Street Smarts program in San Jose, CA, provides a model pedestrian safety education program (see http://www.getstreetsmarts.org for details).

Enforcement

Enforcement of pedestrian and bicycle right-of-way laws and speed limits is an important complement to engineering treatments and education programs.

The City of Lafayette Police Department conducts some enforcement activities related to bicyclist and pedestrian safety.

Suggestion for Potential Improvement

- Implement sustained bicyclist and pedestrian safety enforcement efforts and involve the media. Use enforcement as an opportunity for education by distributing safety pamphlets in-lieu of, or in addition to, citations.

Pedestrian Walking Audit Program

Walking audits provide an interactive opportunity to receive feedback from key stakeholders about the study area and to discuss the feasibility of potential solutions. They can be led by City staff, advocacy groups, neighborhood groups, or consultants.

The City does not have any program, but has conducted walking audits sporadically.

Suggestion for Further Enhancement

- Include regular walking audits in the Citywide pedestrian safety program, based on the suggestions of this CSSA. This effort may complement other "green" or health-oriented programs within the City.

General Plan: Provision for Pedestrian and Bicycle Nodes

Planning principles contained in a city's General Plan can provide an important policy context for developing pedestrian-oriented, walkable areas. Transit-oriented development, higher densities, and mixed uses are important planning tools for pedestrian-oriented areas.

Pedestrian and bicycle nodes are identified, but pedestrian and bicycle accommodations are not identified in the City's General Plan.

Suggestion for Further Enhancement

- Identify pedestrian nodes in future updates to the General Plan.
- Create an overlay district for pedestrian priority areas with special pedestrian-oriented guidelines, such as relaxing auto Level of Service standards and prioritizing pedestrian improvements. Prioritize sidewalk improvement and completion projects in these nodes.

Bike Ordinances (Sidewalk Riding)

The City's local ordinance does not include any section on sidewalk riding.

Suggestion for Potential Improvement:

- Consider an optional helmet ordinance for adults.
- Consider allowing for context-specific flexibility in sidewalk riding policies and enforcement.

Transportation Demand Management (TDM) Programs

TDM programs encourage multimodal travel by incentivizing non-automobile options. As new development occurs, TDM programs can be expanded, formalized, and strengthened.

The City has basic voluntary TDM programs. Lafayette has reduced fee transit passes for City staff, but not for the general public.

Suggestions for Potential Improvement

As part of a comprehensive TDM program:

- Hire or identify a part-time TDM Coordinator.
- Create a TDM program and accompanying website with separate pages for employees, residents, and visitors.

- Establish a Transportation Management Association (TMA) for key commercial and business areas to coordinate parking, transit, and other TDM strategies and policies.

Specific Plans, Overlay Zones, and Other Area Plans

City's Plans require bicycle and pedestrian accommodations, and placemaking.

Suggestion for Further Enhancement

- Continue emphasizing bicyclist and pedestrian-oriented design, walkability, and/or place making in all new specific plans, overlay zones, and other area plans.

Economic Vitality

Improving bicycle and pedestrian safety and walkability can enhance economic vitality. Similarly, enhancing economic vitality through innovative funding options such as Business Improvement Districts (BIDs), parking management, and facade improvement programs can lead to more active areas and encourage walking and bicycling.

The City has several business improvement districts and downtown parking policies

Suggestions for Further Enhancement

- Activate the built environment in business areas through BIDs and façade improvement programs.
- Use wayfinding, walking routes, and events to direct pedestrians to commercial areas throughout the City.
- Install bicycle parking in commercial areas and provide safe, comfortable bike facilities in commercial areas to make in convenient and fun to get to local businesses.

Coordination with Schools

Neighborhood-sized schools, as opposed to mega schools on the periphery, are a key ingredient for encouraging walking and bicycling to school. In addition, pedestrian and ADA improvements could be prioritized near schools.

The City coordinates with schools reactively, to improve routes to schools.

Suggestions for Further Enhancement

- Continue working with the local school districts to establish a policy on neighborhood-sized and oriented schools as part of a Safe Routes to School policy.
- Work with the school districts to establish suggested walking routes and address potential barriers to pedestrian or bicycle access.

Coordination with Transit Agencies

Providing safe and comfortable biking and walking routes to transit stops and stations, and the ability to take bicycles on-board transit vehicles increases the likelihood of multi-modal trips.

Bicycles are accommodated on buses only, with accommodation limited to rack capacity. There are safe and comfortable routes for biking and walking to some transit stops and stations.

Suggestions for Further Enhancement:

- Prioritize implementation of safe routes to transit projects around the transit major corridors.
- Work with transit agencies, Caltrans, and other relevant partners to improve access and safety to stations and bus stops.
- Consider a monthly or quarterly meeting with transit agency stakeholders to discuss issues in the city and how to address them.

OPPORTUNITY

These are areas where the City appears not to meet best practices.

ADA Transition Plan for Streets and Sidewalks

ADA Transition Plans identify gaps and issues in the City's current ADA infrastructure, prioritize projects for implementation, and set forth the process for bringing public facilities into compliance with ADA regulations. Transition plans typically involve a range of locations, such as public buildings, sidewalks, ramps, and other pedestrian facilities. Some cities also have ADA coordinators, who are responsible for administering the Plan and reviewing projects for accessibility considerations.

The City of has no transition plan or ADA coordinator.

Suggestions for Further Enhancement

- Prioritize areas within the City that exhibit greatest pedestrian activity for ADA improvements
- Provide ADA standards and best practice training for engineering staff at all levels.
- Add ADA ramps at intersections that currently lack them and upgrade non-complaint ramps (replacing one ramp to two directional ramps at each corner).
- Consider prioritizing sub-areas within the City that exhibit greatest pedestrian activity.
- Expand the ADA Transition Plan to include the public right-of-way, particularly the downtown area, other priority development areas, bus stops, and schools.

Pedestrian/Bicycle Coordinator

A pedestrian/bicycle coordinator provides guidance for pedestrian/bicycle planning efforts and oversees implementation of plans. In a sampling of pedestrian-oriented California cities, a common denominator among cities (with a population over 100,000) is a full-time pedestrian/bicycle coordinator.

The City does not currently have a Pedestrian or Bicycle Coordinator.

Suggestion for Potential Improvement

- Designate a staff member to fill the role of Pedestrian/Bicycle Coordinator to include interdepartmental coordination, grant writing, and staff liaison to local non-profits, advocacy groups, and schools.

Safe Routes to Schools Program

Safe Routes to School (SRTS) programs encourage children to safely walk or bicycle to school. The Marin County Bicycle Coalition was an early champion of the concept, which has spread nationally (refer to best practices at www.saferoutestoschools.org). SRTS programs are important both for increasing physical activity (and reducing childhood obesity) and for reducing morning traffic associated with school drop-off (as much as 30% of morning peak hour traffic).

The City does not have a Safe Routes to Schools program and has not obtained recent funding, although in the past they have received some funding for safe routes to school program.

Suggestion for Potential Improvement

- Consider a plan for all Lafayette schools to conduct walk audits, identify potential safety improvements, and secure funding for those improvements.

Shared Mobility Services

Shared mobility services are transportation services—typically offered by private companies—that offer ride-share services (e.g., Lyft or Uber) for both solo and pooled trips, bike share, and scooter share. Policies for shared mobility services can allow cities to encourage, prohibit, or direct how they want shared mobility to work in their city. They can allow for curb space management, clear organization of sidewalk space, and encourage (or discourage) private vendors to come to the city. Curb space management is a practice that requires curb access to be planned, designed, operated, and maintained to enable curb utilization with safe, convenient, and multimodal access for all transportation users.

The City does not have curbside management, shared mobility, or micromobility policies in place.

Suggestions for Potential Improvement

- Adopt a curb management plan to designate how the City will prioritize and proactive plan for curb uses (e.g., parking, passenger loading, commercial loading, ADA loading and parking, bicycle parking, bus-only lanes) and to make sure that the curb has the highest and best use of space.

- Consider micromobility policies (e.g., permitting, enforcement) in place to prioritize pedestrian and bicyclist safety and keep the sidewalk organized and usable for people of all abilities.

Funding

A dedicated, annual funding stream for bicycle and pedestrian projects ensures that these types of projects will be implemented regularly. Bicycle and pedestrian projects can also be integrated in the other work that the City does, including repaving and other routine maintenance of the roadway network.

The City has only been moderately successful in obtaining grant funding.

Suggestion for Further Enhancement

- Collaborate with other agencies and continue applying for grant funding for both infrastructure and non-infrastructure projects.
- Integrate bicycle and pedestrian projects into the site plan review process for new developments.
- Secure additional funding for repaving projects to allow for "quick build" projects and other bicycle and pedestrian safety improvements to be integrated into those projects.
- Establish a dedicated funding source for pedestrian and bicycle projects.

Collision History and Collision Reporting Practices

Identifying and responding to collision patterns on a regular basis is an important reactive approach to bicycle and pedestrian safety, which may be combined with other proactive measures. This is the traditional way most cities have approached safety. However, many are now looking to proactive safety to address safety issues on a system-wide basis. This is often paired with a policy goal of getting to zero fatality or severe injury collisions (commonly referred to as "Vision Zero").

The City does not have set practices for data review, although when they have adequate staff, the transportation planner reviews collision data as part of any traffic calming or traffic safety request.

Suggestions for Further Enhancement

- Adopt a data driven systemic safety approach, which would include a systematic approach to identifying, prioritizing, and ultimately implementing safety countermeasure and/or a formal commitment to Vision Zero.
- Work with elected officials and department heads to adopt a Vision Zero policy formally stating the City's commitment to reducing the number of traffic-related fatalities and severe injuries to zero.
- Additionally, with sufficient pedestrian and bicycle volume data, the City could prioritize collision locations based on collision rates (i.e., collisions/daily pedestrian or bicycle

volume), a practice that results in a more complete safety needs assessment. Treatments could then be identified for each location and programmatic funding allocated in the City's Capital Improvements Program (CIP).

- Consider utilizing SafeTREC's Transportation Injury Mapping System (TIMS) https://tims.berkeley.edu/. TIMS provides quick, easy and free access to California collision data, the Statewide Integrated Traffic Records System (SWITRS) that has been geo-coded by SafeTREC to make it easy to map out collisions.

Bicycle Network Implementation Practices

Some traffic calming measures are implemented in conjunction with bikeway installations. Bicycle Level of Traffic Stress (LTS) was originally developed by researchers at the Mineta Transportation Institute. LTS assesses the comfort and connectivity of bicycle networks. As a safe practice, age 8 to 80 bicyclist considerations need to be applied and/or level of traffic stress be considered

In Lafayette, some treatments are implemented where they fit within the right-of-way and vehicle LOS is not affected.

Suggestions for Further Enhancement:

- Consider prioritizing bicycle projects to align with roadway resurfacing and projects that are near school sites.
- Secure enough funding for repaving and other complete streets projects to allow for installation of protected bike facilities and intersection improvements.
- Consider using LTS to strategically implement bikeways and traffic calming treatments that would improve LTS of existing bikeways.

Traffic Signal and Stop Sign Warrants

Providing signal control at an intersection may improve pedestrian safety by reducing speeds and controlling pedestrian-vehicle conflicts. Installing bicycle signals and limiting stop signs on bicycle routes may enhance bicycle mobility and safety. The CAMUTCD defines warrants for installing signals. Although following CAMUTCD warrants for installation of traffic signals is a good practice, the City may choose to define relaxed pedestrian criteria to encourage pedestrian safety.

The City of Lafayette uses MUTCD warrants.

Suggestion for Potential Improvement:

- Consider developing City-specific signal and stop sign warrants that are pedestrian- and bicycle-friendly.
- Consider installing bicycle detection at signalized intersections.

Sidewalk furniture or other sidewalk zone policies

Street furniture encourages walking by accommodating pedestrians with benches to rest along the route or wait for transit; trash receptacles to maintain a clean environment; street trees for shade, and other facilities. Uniform street furniture requirements also enhance the design of the pedestrian realm and may improve economic vitality.

There are no design standards requiring implementation of the sidewalk zone system.

Suggestion for Potential Improvement

- Adopt a Street Furniture Ordinance to include locations and furniture amenities other than those associated with transit stops, as appropriate.

Bicycle Parking Requirements

Safe and convenient bicycle parking is essential for encouraging bicycle travel (especially in lieu of vehicle travel). Bicycle parking can also facilitate last-mile connections between two modes, such as bicycle parking at a transit station. To be effective, bicycle parking must be visible and secure and have enough capacity to accommodate bicycle demand, both long-term and short-term. Long-term and short-term parking can be implemented through a bicycle parking ordinance as in the City of Oakland (see details at http://www2.oaklandnet.com/Government/o/PWA/o/EC/s/BicycleandPedestrianProgram/OAK024596).

No bike parking ordinance or program in place in Lafayette.

Suggestion for Potential Improvement:

- Implement short-term and long-term, secured bicycle parking at all new development, consistent with the Bicycle and Pedestrian Master Plan and the APBP Bicycle Parking Guidelines, 2nd edition.
- Site bicycle racks to be convenient for bicyclists, out of the way of pedestrians, and with good visibility for security, consistent with the APBP Bicycle Parking Guidelines, 2nd edition.
- Consider implementation of “branded” racks for the City (with a unique design or City symbol).

Bicycling Safety Audit Program

When City staff and key stakeholders ride along study corridors and experience key route and crossing challenges and best practices, consensus is more readily reached on a vision and action plan for safety enhancements.

The City of Lafayette does not have bicycling safety audit programs.

Suggestions for Further Enhancement:

- Include regular bicycling audits in the citywide bicycle safety program, based on the suggestions of this CSSA. This effort could complement other sustainability or health-oriented programs within the City.
- Encourage interdepartmental participation between the Planning and Public Works. If possible, encourage Bicycle and Pedestrian Advisory Committee and City Council members to participate.
- Routinely conduct bicycle safety audits of key corridors throughout the City, including those with recent improvements, those with heavy bicycle demand, and those with high collision rates

Proactive Approach to Institutional Coordination

Institutional coordination associated with multiple agencies is a critical part of the work of any municipality. Non-local control of right-of-way and differing policies regarding pedestrian and bicyclist accommodation can make the work complex.

The City does not have any identified obstacles.

Suggestions for Further Enhancement

- Work with school district to identify and implement bicycle and pedestrian safety improvements and programs at each school site.
- Work with transit agencies to improve complete streets safety throughout the City to provide safe walking and biking routes to transit stops.

Historic Sites

Historic walking routes or bike trails, such as the Freedom Trail in Boston, encourage active transportation and enhance economic vitality.

Suggestion for Potential Improvement

- Consider establishing walking and biking routes showcasing key destinations in the City's historic district.

Coordination with Emergency Response

Emergency response requires special roadway design considerations that sometimes conflict with bicycle and pedestrian treatments. One example is the design of turning radii at intersections. Bicyclists and pedestrians benefit from the reduced vehicle speeds of smaller radii, but larger vehicles, such as fire trucks, have more difficulty performing the turn within the smaller space. These conflicts require consensus building between the City and the respective departments. Consensus building could include pilot testing of alternative treatments, such as a model traffic circle in an open field.

Emergency response is not involved in bicycle/pedestrian facility planning and design in Lafayette.

Suggestions for Further Enhancement:

- Balance the trade-off between traffic calming safety treatments such as roundabouts or partial street closures and longer emergency response times.
- Encourage emergency and transit responders to participate in test runs of roadway designs that are aimed to reduce speed and improve bicycling access.
- Collaborate with schools on projects beyond the school district boundaries.

Coordination with Health Agencies

Involving non-traditional partners such as public health agencies, pediatricians, etc., in the planning or design of pedestrian and bicycle facilities may create opportunities to be more proactive with pedestrian and bicycle safety, identify pedestrian and bicycle safety challenges and education venues, and secure funding. Additionally, under-reporting of pedestrian-vehicle and bicycle-vehicle collisions could be a problem that may be partially mitigated by involving the medical community in pedestrian and bicycle safety planning.[1]

Health agencies are not involved in bicycle/pedestrian safety or active transportation in Lafayette.

Suggestions for Further Enhancement:

- Consider partnerships with the County Public Health agency and environmental groups to make transportation an element of healthy living and positive health outcomes.

[1] Sciortino, S., Vassar, M., Radetsky, M. and M. Knudson, "San Francisco Pedestrian Injury Surveillance: Mapping, Underreporting, and Injury Severity in Police and Hospital Records," *Accident Analysis and Prevention*, Volume 37, Issue 6, November 2005, Pages 1102-1113

4. COMPLETE STREETS AUDIT RESULTS AND SUGGESTIONS

4.1. OVERVIEW

Complete Streets audits are typically conducted as an initial step to improve the street environment for all travel modes within the selected area. Many individuals can participate: residents, stakeholders, and affiliated individuals. During the audits, positive practices are observed and issues and opportunity areas are noted. Observations are made of the interactions among motorists, pedestrians, and bicyclists. Observations are based on the behavior of these different road users, particularly at intersections. For each opportunity area, the group discusses possible suggestions to address safety and operational concerns. Complete Streets audits are highly interactive, with many field observations. The audits are a means to observing and learning how to "see through the eyes of pedestrians and bicyclists."

This chapter presents observations and suggestions made during conference calls and field observations conducted during July 2020.

Suggestions in this chapter are based on best practices and discussions with the participants regarding local needs and feasibility. It should be noted that these suggestions are based on limited field observations and time spent in Lafayette by the CSSA evaluator. These suggestions are intended to guide City staff in making decisions for future safety improvement projects in the City; they may not incorporate all factors relevant to pedestrian and bicycling safety issues in the City. This report is conceptual in nature, and conditions may exist in the focus areas that were not observed and may not be compatible with suggestions presented below. Before finalizing and implementing any physical changes, City staff may choose to conduct more detailed studies or further analysis to refine or discard the suggestions in this report, if they are found to be contextually inappropriate or appear not to improve bicycling or pedestrian safety or accessibility due to conditions including, but not limited to, high vehicular traffic volume or speeds, physical limitations on space or sight distance, or other potential safety concerns.

4.2. BACKGROUND

#	Focal Area	Issues
1	Vicinity of Lafayette Elementary School and Stanley Middle School	Safety and convenience of pedestrian and bicycle travel along and across Moraga Road and School Street
2	Vicinity of Acalanes High School and Springhill Elementary School	Safety and convenience of pedestrian and bicycle travel along and across Pleasant Hill Road, Springhill Road, and Pleasant Hill Road's intersections with Deer Hill Road / Stanley Boulevard and Springhill Road.
3	Vicinity of Burton Valley Elementary School	Safety and convenience of accessing the school's three entrances on foot and bicycle. Suggested routes to school for walkers and bicycle users.

Figure 4-1 places these three focal areas on a portion of the Lafayette School District elementary school attendance boundary map:

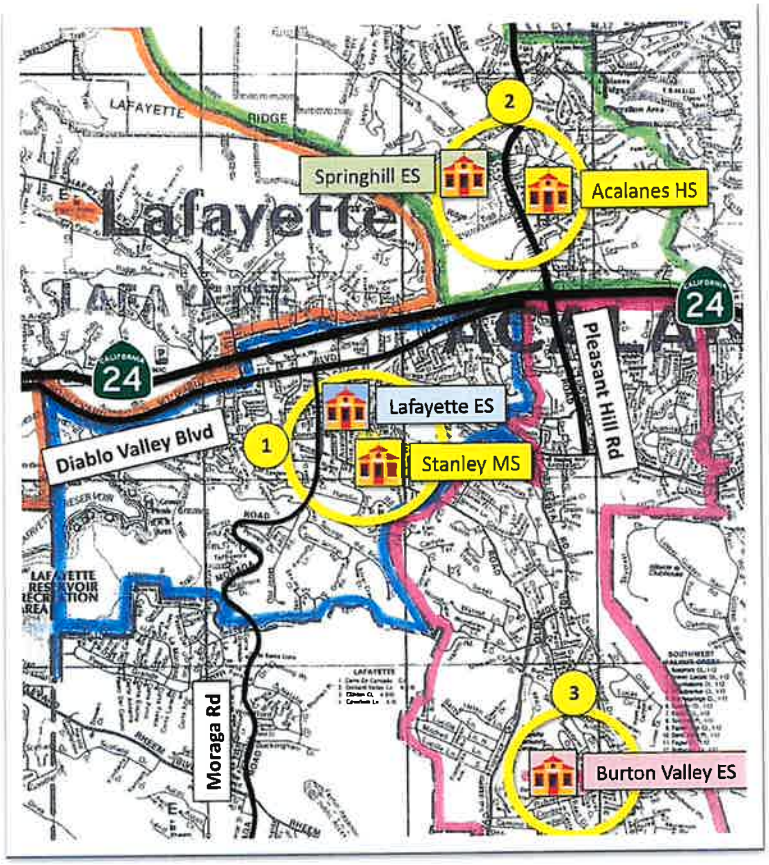


Figure 4-1: Map of focal areas

Section 4.3 presents key issues and suggestions identified during the audit that can be applied citywide. Subsequent sections address each focal area; each concludes with a summary of suggestions for that area.

4.3. GENERAL CITYWIDE SUGGESTIONS

The following general suggestions for physical enhancements are appropriate either Citywide or in two or more of the focal areas. These are discussed in detail below.

Table 4-1: General Suggestions for Physical Enhancements

Pedestrian	**Details**
Advance Limit Lines (STOP bars)	Install 4' in advance of the limit line or first crosswalk line on STOP and signal-controlled approaches, to deter motorists from encroaching into the crosswalk or blocking sightlines to low pedestrians such as wheelchair users.
Corner curb extensions	Enable pedestrians to make a starting decision where they can see and be seen. Calm inbound right turns by reducing the physical radius. Shorten crosswalks.
Interim curb extensions	Consider Painted Safety Zone / Interim Curb Extension treatments at locations where the need is current but hardscape curb extensions are subject to future funding.
Crosswalk markings	At uncontrolled crosswalks, incorporate wide longitudinal elements (e.g., "ladder rungs") to enable approaching drivers to recognize the crosswalk earlier.
Leading Ped. Interval	Display WALK phase (typically) 3 seconds before same-direction green indication, so pedestrians can occupy the curb lane.
Center islands on side streets	Calm inbound turns. May enable bicyclists preparing to turn left or proceed through to wait further forward than they otherwise would.
Left-side warning signs: symbol orientation	Pedestrian symbol (W11-2) or trail crossing signs (W11-15) installed on the left side of street may depict users approaching, just as the W16-7p Downward Pointing Arrow always points into the approach. (MUTCD 2A.06 Design of Signs specifically allows mirror images. However, sign catalogs may not designate a unique product code.)
Left-side signs on medians	At uncontrolled locations where it is feasible to add a raised median to protect a sign, do this so that each approach sees a pair of warning signs on its side of the street.
Upstream sightlines	Prohibit parking for at least 1 car length upstream of crosswalk, to keep sightlines open to approaching traffic. A curb extension can ensure compliance and is a good place for crosswalk warning signs. "Bike corrals" (in-street racks) can also utilize this area.
Yield Lines	Install on multi-lane approaches to uncontrolled crosswalks, 20'-50' before the crosswalk.
Directional curb ramps	Provide 2 ramps per corner, aligned with sidewalks, rather than diagonal ramps.
Accessibility	Ensure that signal actuation is ADA compliant, including pushbutton height.
Centerline	Install no-passing (double yellow) centerline 50' back from crosswalk.
Bicycle	**Details**
Detection	Install bicycle and motorcycle detection at through, left turn, and bicycle lanes on all actuated approaches. Required by state law for new and modified traffic signals.
Right turn lanes	Where total width is insufficient to add a through bike lane, install left-aligned sharrows in the turn lane and R118 (CA) "Except Bicycles" plaques on right-turn only signs.
Wayfinding	Install bicycle guide signage to destinations served by bike routes, with the destination name(s), direction(s), and optionally distance(s).

Advance Limit Lines (STOP bars)

On approaches to crosswalks that are controlled by signals or STOP signs, installing an advance limit line (a.k.a. "STOP bar") a short distance (typically 4 feet) before the crosswalk can remind motorists to stop far enough back that their vehicle's front end does not encroach into the

crosswalk. Such encroachment can be a safety issue at multi-lane approaches when the front end of a vehicle waiting can hide a low pedestrian (child or wheelchair user) approaching across another lane.

MUTCD Section 3B.16 Stop and Yield Lines applies. Guidance Paragraph #10 states:

> *10 If used, stop and yield lines should be placed a minimum of 4 feet in advance of the nearest crosswalk line at controlled intersections, except… at mid-block crosswalks.*

Corner curb extensions

At intersections with conventional corners and no curb extensions, pedestrians preparing to cross a street typically make their crossing decisions before stepping off the curb, i.e., while on the sidewalk. Due to substantial corner radii at most intersections, this places them over 10 feet outside of the first travel lane they will enter. Corner curb extensions (bulb-outs) enable pedestrians to safely make their decision near the outside travel lane, where they are more visible to approaching motorists and also have a considerably shorter distance to cross. Raised curb extensions also enable crosswalk warning sign assemblies to be installed closer to the travel lanes where they are more visible to motorists. One resource for curb extensions is NACTO's Urban Street Design Guide section:

https://nacto.org/publication/urban-street-design-guide/street-design-elements/curb-extensions/

Curb extensions attached to the street's existing curb can be expensive to construct because they must preserve drainage along the street and provide accessible slopes and curb ramps. However, the same safety benefits can be obtained with less expense and without modifying drainage if the extension area is segmented into "floating" islands between which pedestrians including wheelchair users travel at existing street grade.

"Temporary Traffic Calming Curbs" (Calgary, AB)

Figure 4-2: Segmented floating corner island treatment

Interim curb extensions

Many cities are now deploying treatments consisting only of painted lines, colored paint or epoxy fill, and tubular delineators to rapidly and inexpensively create corner-bulb installations in advance

of funding availability for hardscape versions (Figure 4-3). These go by various names such as "Painted Safety Zones" (San Francisco), "Painted Curb Extensions" (Pasadena), "Painted Bulbouts" (Denver) and "Interim curb bulbs" (Seattle).

San Francisco MTA writes:

> Painted safety zones are painted road areas that wrap around sidewalk corners to make pedestrian crossing intersections more visible to people driving. Painted safety zones are often flanked by delineators (white posts) and encourage people who drive to slow down, especially when making turns.
>
> https://www.sfmta.com/getting-around/walk/pedestrian-toolkit

Seattle DOT (SDOT) writes:

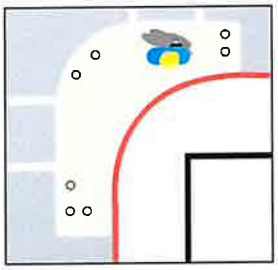
> Interim curb bulbs may be appropriate in locations where there is a safety need and a permanent solution is not feasible in the short term, and/or where there is a planned capital improvement within 5 years. At intersections with curb and gutter, an interim curb bulb can only be done [where] there are existing curb ramps. In some cases, curb bulbs may also be integrated with bioretention to manage storm water runoff from the right-of-way.
>
> https://streetsillustrated.seattle.gov/urban-design/adaptive-design/intersection-treatments/

Crosswalk marking patterns – high visibility and contrast edge

The standard crosswalk-marking scheme at controlled approaches has 2 transverse lines and no fill pattern. Many cities use the standard pattern at controlled approaches and a high-visibility pattern at uncontrolled approaches. The following description from San Francisco MTA's crosswalk design guidelines describes the safety advantages of high-visibility markings:

> *Because of the low approach angle at which drivers view pavement markings, the use of longitudinal stripes in addition to or in place of the standard transverse markings can significantly increase the visibility of a crosswalk to oncoming traffic. While research has not shown a direct link between increased crosswalk visibility and increased pedestrian safety, high-visibility crosswalks have been shown to increase motorist yielding and channelization of pedestrians, leading the Federal Highway Administration (FHWA) to conclude that high-visibility pedestrian crosswalks have a positive effect on pedestrian and driver behavior.*

Los Angeles (Cesar Chavez & St Louis)



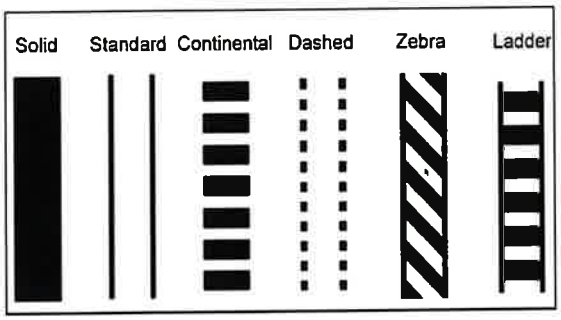
Pasadena Street Design Guide

Los Angeles – Pico & Curson

San Francisco (16th St & Kansas St)

Seattle (Burke-Gilman Trail & 40th Ave NE & NE 52nd Pl)

Figure 4-3: Paint-and-delineator curb extensions



(Figure 12 from FHWA report HRT-04-100, "Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations Final Report and Recommended Guidelines")

Figure 4-4: Crosswalk marking patterns (FHWA)

Table 4-2 lists suggested treatments for several crosswalk elements.

Table 4-2: Suggested Crosswalk Treatments

	Approach	Controlled		Uncontrolled	
Elements	**Median**	**None or painted**	**Raised**	**None or painted**	**Raised**
Crosswalk markings		2-line		High-visibility (ladder)	
Warning signs at crosswalk		None		Curbside, 2-sided ("2-sign")	Curbside: 1-sided Median: 2-sided ("4-sign")
RRFBs on crosswalk signs		None		If needed	
Advance markings & signs		Advance limit line 4' upstream		Yield line 20'-50' upstream R1-5 Yield Here signs at yield lines	
Advance warning signs		None		If needed, per MUTCD	

Low-vision pedestrians (persons who are not completely blind) benefit from a continuous "contrast edge" for guidance when crossing streets. The solid transverse lines in the "solid," "standard," "zebra" and "ladder" patterns provide this; the "continental" and "dashed" patterns do not. For all crosswalks at uncontrolled approaches that currently use the continental pattern, it is suggested to add two solid transverse lines to create a ladder pattern.

In prior decades, "artistic" crosswalks were constructed in which the transverse border was a wide cast concrete strip with no retroreflective white marking (12-inch line). Over time the contrast between these strips and the middle of the crosswalk is reduced so the strips no longer provide an effective contrast edge for low-vision pedestrians. In such cases, 12-inch transverse lines (white for non-school crosswalks, yellow for school crosswalks) may be incorporated.

Leading Pedestrian Interval

Leading Pedestrian Interval (LPI) traffic signal phasing displays the pedestrian signal's WALK indication for 3-7 seconds before the green indication for same-direction traffic. LPI gives pedestrians a head start to occupy the crosswalk before turning vehicles. A 2000 study by the Insurance Institute for Highway Safety (IIHS) found that LPI reduces conflicts between turning vehicles and pedestrians.

> *Field Evaluation of a Leading Pedestrian Interval Signal Phase at Three Urban Intersections.* Van Houten, Retting, Farmer, Van Houten. Transportation Research Record (TRR) 2000.

It is suggested that the City consider implementing LPI at signals with high pedestrian activity, prohibiting right-turn-on-red as needed per recent research findings.

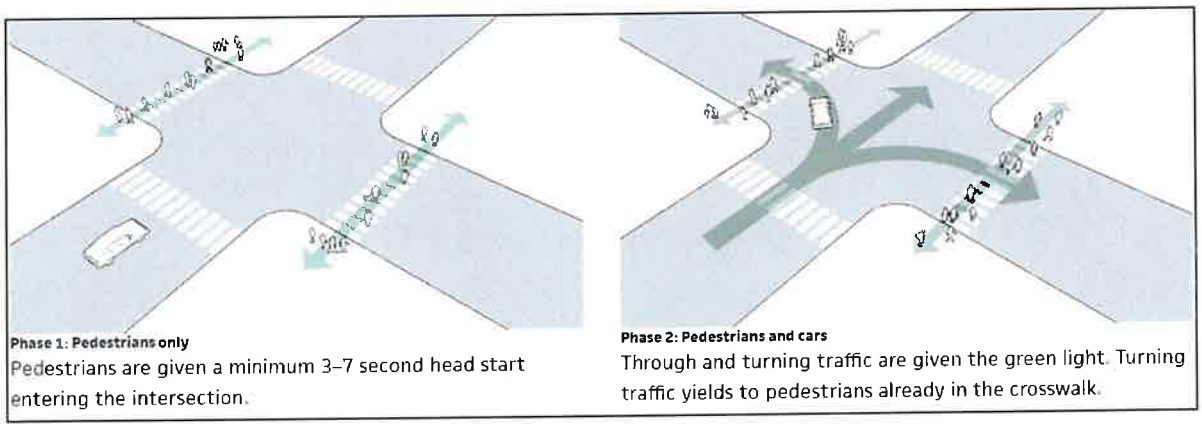


Figure 4-5: Leading Pedestrian Interval phases

Center islands on side streets

Adding pill-shaped center islands just behind the crosswalks side streets at some intersections can improve safety in several ways:

- Calm right turns from the major street
- Calm left turns onto the major street
- Calm through movements on the side street
- Provide a modest refuge for pedestrians crossing the side street, especially slow ones
- Enable the limit lines to be moved forward for better sightlines
- Provide a sheltered place for bicycle users approaching on the side street to prepare to cross or enter the major street

Figure 4-6 shows such an island on a 40-foot residential street in Sunnyvale CA (Canary Drive, at Inverness Way). The island is 6 feet wide and 20 feet long.

Figure 4-6: Median island on residential street (Canary at Inverness, Sunnyvale CA)

4.4. FOCAL AREAS

The following sections address each of the three focal areas listed in Section 4.2.

4.4.1. Area #1: Vicinity of Lafayette Elementary School and Stanley Middle School

Existing conditions

Lafayette Elementary School and Stanley Middle School are located near downtown in the area depicted in Figure 4-7. Both schools' attendance boundaries extend well beyond the figure.

Figure 4-7: Lafayette Elementary School and MH Stanley Middle School – context

Moraga Road is an arterial street that—along with St. Mary's Road—carries substantial traffic to/from downtown, the BART station, and the Highway 24 freeway. Students cross at one of three traffic signals at T-intersections: Moraga Boulevard, Brook Street and School Street. The latter

two are adjacent and operate as a combined signal. Brook's signal has an all-walk phase and a diagonal crosswalk. Table 4-3 lists Moraga Road's widths and layouts within and near the focal area. The parking lane and east shoulder are not marked as bike areas.

Table 4-3: Moraga Road segment widths and layout

Segment	W	Layout
200' S of Mt Diablo Blvd – Brook	56'	2 traffic lanes each way, narrow E shoulder, W-side parking lane
Brook – School	52'	2 traffic lanes each way, narrow E and W shoulders
School – Rosedale	48'	2 traffic lanes each way, no shoulders
Rosedale – 220' N of St Mary's	56'	2 traffic lanes each way, W-side parking lane

The posted speed limit is 25 mph, and there is a SCHOOL SPEED LIMIT 20 When Children Are Present sign.

Bus stops (County Connection Line 6) are located at the southeast corner at Moraga Boulevard (northbound) and the northwest corner at Brook Street (southbound).

Pedestrian accommodation in the focal area is as follows:

Street	Sidewalks
Moraga Rd, School St, Brook St, Moraga Bl	Both sides
Rosedale Avenue	North side, first two parcels only
First St (one-way southbound for vehicles)	West side: sidewalk. **East side: shared-use path**
Monroe Ave	South side only
Avalon Ave	West side: sidewalk only along corner parcel East side: narrow discontinuous walkway
Avalon Ct, Paradise Ct, Topper Ct	No sidewalks (very low traffic volume)
Topper Lane	No sidewalks. Vehicle congestion and heavy pedestrian and bicycle use expected during school commute.
Lafayette-Moraga Regional Trail	Paved shared-use path with access from School Street at Stanley Middle School and Topper Court

City staff shared the following:

- Moraga Road and St. Mary's Road are major corridors for commute traffic to / from freeway. Through traffic uses Moraga Road.
- The City conducted a congestion reduction study for this corridor that explored traffic-reducing options including remote drop-off of schoolchildren.
- There have been few collisions, but many close calls are reported especially on streets with limited right of way where walkers are close to motor traffic. However, a 60-year-old

pedestrian in the east crosswalk at Moraga Boulevard on the afternoon of Monday July 24, 2017 was struck by a westbound pickup truck and died later that day.

- The City has applied to improve sidewalk conditions along School Street by undergrounding utilities and removing poles. No grants have been awarded for this.

Observations (Moraga Road)

The evaluator visited this area on Wednesday August 5 and walked Moraga Road between Moraga Boulevard and School Street, and School Street east to the Regional Trail.

Moraga Road corridor

Some adult bicyclists were observed on Moraga Road between Moraga Boulevard and School Street, but most bicyclists used the sidewalk. These included school-age children traveling alone, in small groups, or accompanied by parents. Sidewalk bicycling indicates that those users do not feel comfortable on the street because bicycle facilities appropriate for their skills or traffic tolerance are not present.

Figure 4-8: Moraga Road south crosswalk at Moraga Boulevard

Moraga Road / Moraga Boulevard traffic signal

Moraga Boulevard intersects from the east; Lafayette United Methodist Church's driveway is the west leg. A small medical office building occupies the southeast corner. A shopping plaza occupies the northeast corner, with a KEEP CLEAR area across its two-way south driveway.

High-visibility yellow (school) crosswalks are present on the south and east legs. The northeast and southeast corners have single 45-degree curb ramps. The west end of the south crosswalk has a parallel ramp. Pedestrian pushbutton locations, types (low-force buttons), mounting heights and orientations are acceptable for access by wheelchair users and small children.

Figure 4-9: Moraga Road / Moraga Boulevard intersection

Analysis (Moraga Road)

Providing two traffic lanes each way on Moraga Road maximizes through motor vehicle capacity but provides no comfortable on-street accommodation for bicyclists, so only traffic-tolerant adults choose to ride in the street. Sidewalk bicyclists conflict with pedestrians and risk collisions at driveways because sight triangles are typically insufficient at bicycle speeds.

The four-lane configuration with no turn lane requires left turns to be made from the inside lanes, limits the use of protected turn phasing, and prevents the installation of median refuges for safe mid-block crossings where the nearest intersections are distant.

Using inside lanes for left turns reduces their through traffic capacity. Depending on left turn volume, a street's through traffic may be considerably lower than four lanes would suggest. Motorists stopped waiting for left turns risk rear-end collisions and cause other to change lanes, sometimes unsafely. With more than one through lane, impatient drivers set the pace.

Suggestions (Moraga Boulevard signal)

- Install Advance Limit Lines 4' before crosswalks to deter encroaching.
- Consider adding a Leading Pedestrian Interval phase for northbound right turns (to enable pedestrians on the east leg to occupy the crosswalk on a fresh green)

Moraga Road / Brook Street traffic signal

Brook Street intersects Moraga Road from the west. Lafayette Elementary's south driveway is on the east side just to the north. The signal is operated together with School Street, just to the south. It has an all-walk phase supported by activated blank-out No Right Turn signs, during which pedestrians can also cross diagonally between the southwest and northeast corners.

High visibility yellow (school) crosswalks are present on the north and west legs, and on the northwest-southeast diagonal. The northwest and southwest corners have single 45-degree curb ramps. The north crosswalk has a directional ramp at the east sidewalk.

a) Aerial

b) Single shared ped displays on SW and NE corners are off-axis to both served crosswalks

Figure 4-10: Moraga Road / Brook Street intersection

The northeast corner pedestrian button is located on the north face of the mast arm pole. Adding a button on the south face—the same side as the curb ramp—would benefit pedestrians including wheelchair users.

The northeast and southwest corners have single pedestrian displays, each oriented at an angle midway between the alignments of the two marked crosswalks they serve. In this off-axis orientation the displays' programmed visibility grids significantly reduce legibility (see Figure 4-10(b)). It is suggested to add a second display to each corner and dedicate each display to one crosswalk by aligning it directly toward that crosswalk.

A middle school-age child bicycling southbound on the west sidewalk approached Brook. Southbound Moraga Road had a green indication but the west crosswalk's north-facing pedestrian display (i.e., for her through movement) showed "DON'T WALK." The child pressed the pedestrian button many times, but the "DON'T WALK" continued for a considerable time. Eventually the southbound WALK indication appeared and she continued south via the west crosswalk and sidewalk. The City might consider displaying the WALK indication for the west crosswalk while Moraga Road has the green.

Moraga Road / School Street traffic signal

School Street intersects Moraga Road from the east at a slightly skewed T-intersection. The traffic signal is operated together with the one at Brook Street, a short distance north. A small dental and veterinary office building occupies the west side of Moraga Road; its driveway is at the intersection's northwest corner.

Figure 4-11: Moraga Road / School Street intersection

School (yellow) crosswalks are marked on the east and south legs. The northeast and southeast corners have single angled curb ramps. The west end of the south crosswalk has a parallel ramp. Pedestrian pushbutton locations, types (low-force buttons), mounting heights and orientations are acceptable for access by wheelchair users and small children.

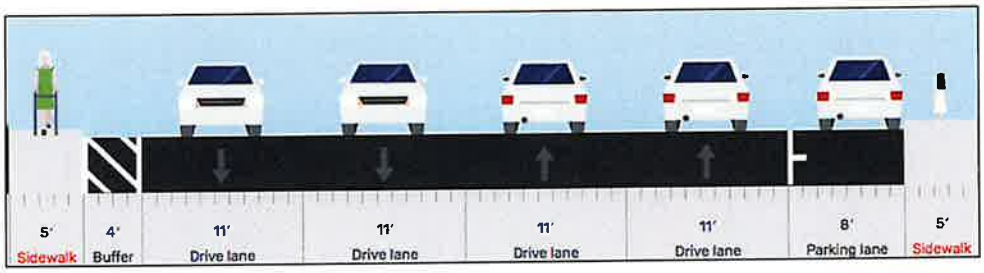
Suggestions (Moraga Boulevard corridor)

A classic 4-to-3 lane reassignment ("road diet") on Moraga Road would benefit safety by:

- Adding bike lanes, which would remove bicycle conflicts from sidewalks, driveway crossings and crosswalks
- Adding a center turn lane, which would:
  - Facilitate protected left turns at signals, reducing crosswalk turning conflicts
  - Facilitate mid-block left turns into and out of driveways, including those of Lafayette Elementary, by providing a safe place to wait before or after the move
  - Eliminate lane-changing by motorists swerving to avoid stopped left-turners
  - Improve commercial vitality by enabling installation of median refuge-protected mid-block crosswalks, potentially at Fiesta Square shopping center (over 300' to nearest crosswalks; 2.5-minute one-way pedestrian detour)
- Reducing speeding, because prudent drivers set the pace in a single lane. This can reduce injuries and severity—especially to pedestrians and bicyclists—in four ways, by:
  - Reducing kinetic (impact) energy, which increases as the square of speed (twice as much energy at 35 mph vs. 25 mph)
  - Reducing braking distance, which tracks kinetic energy (square of speed)
  - Resolving more conflicts with negotiation and braking vs. collisions
  - Widening motorists' field of view (more peripheral vision used at lower speeds)

A road 4-to-3 conversion will work on all segments listed in Table 4-3. Figure 4-12 shows a Streetmix concept for the northernmost (56' wide) segment. The view is facing south.

a) Existing



b) Suggested

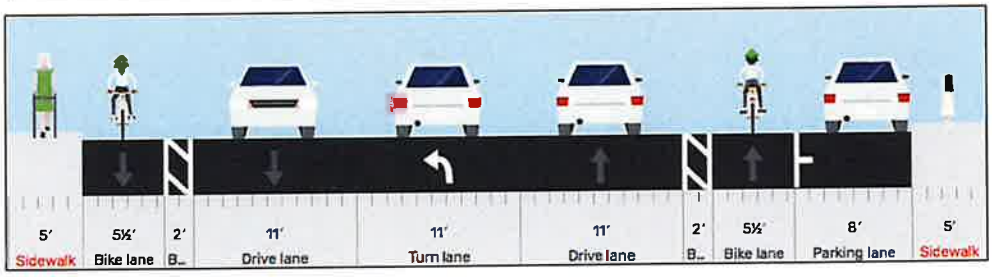


Figure 4-12: Moraga Boulevard road diet concept (Moraga Blvd. – Brook St. segment)

Summary of suggestions (Moraga Road)

Table 4-4: Suggestions for Moraga Road between Moraga Boulevard and School Street

#	Location	Item	Suggestion
1	Moraga Blvd, Brook Street and School Street signals	Approaches to crosswalks	Install advance limit lines (STOP bars) 4 feet before the crosswalks, to deter motorist encroachment
2	Brook Street signal, NE and SW corners	Single pedestrian display, visibility	Install second pedestrian display at each corner. Orient each display directly toward one crosswalk.
3	Brook Street signal, west crosswalk	WALK phase with Moraga Road green	Consider displaying WALK indication while Moraga Road's through movement has a green indication
4	School Street signal	Left turns from Moraga Road	Consider protected left turn, which would remove vehicle conflicts from pedestrians' crossing phases.
5		Leading Pedestrian Interval	Consider to enable pedestrians to occupy the curb lane before same-direction motorist right turns on a fresh green.
6	Moraga Road between St. Mary's and Mt. Diablo Blvd.	Layout	Consider a 4-to-3 lane reassignment ("road diet") to add bike lanes and a center turn lane. See above list of safety and operational advantages.

Observations (School Street)

First Street

First Street runs north-south for three blocks between Golden Gate Way—the south edge of the Mt. Diablo Road commercial corridor—and School Street. It is one-way southbound for motor traffic. It has a sidewalk on the west side and a two-way shared use path on the east side—a good low-stress bikeway. However, at the north end of the path there is currently no wayfinding to the Library or Lafayette Park, both of which are within one block, or to the Lafayette BART station. Completing these "last mile" connections would increase the bikeway's utility.

First Street's approach to School Street has two lanes (right-only and left-only). Two wide white transverse lines with KEEP CLEAR word messages bracket the intersection. First has north-facing STOP signs on both sides, with double-sided south-pointing R6-1 ONE WAY arrows atop the signs and R5-1 DO NOT ENTER signs on the back (south-facing) sides. The R5-1 signs are faded and should be replaced. To improve their visibility it is suggested to angle the west sign toward westbound traffic on School Street and the east sign toward eastbound traffic.

A high-visibility yellow (school) crosswalk is marked across First Street. The uncontrolled west and east leg crosswalks are not marked—perhaps because pedestrians are encouraged to cross at Avalon Avenue, one short block to the east. At the south sidewalk, the west leg has a curb ramp and the east leg has a driveway apron.

Parking is currently permitted on the eastbound approach immediately upstream of the unmarked west crosswalk. It should be prohibited for one car length upstream.

The R3-1 No Left Turn sign facing eastbound School Street before First Street was obscured by vegetation. The vegetation should be trimmed back to the rear of the sidewalk and maintained.

a) R3-1 No Left Turn sign was obscured by adjacent vegetation (shown trimmed back in this photo).

Car parked upstream of unmarked west crosswalk could hide pedestrians.

b) Replace faded Do Not Enter signs.

Consider angling the left-side Do Not Enter sign toward westbound traffic and the east sign toward eastbound traffic.

Figure 4-13: School Street at First Street

Bicycle connection between First Street and Regional Trail

Bicycle users—including students—using School Street between the south end of First Street and the Regional Trail access point 1,000' east either ride in the street or on the north sidewalk. School Street is 36' wide with a double-yellow (no passing) centerline and parallel parking on both sides except along the frontage of MH Stanley Middle School. Because each half of the street is only 18' wide and approximately 8' is occupied by parked vehicles (with a 3-foot door zone), the safest position for on-street bicyclists is to occupy the 7 feet closest to the centerline.

This is a situation in which what bicycle safety professionals consider to be the safest action (i.e., to "single up" in line with motor traffic, which is moving slowly) feels uncomfortable for those who do not understand the reasoning or who are uncomfortable merging, while the unsafe action (riding too close to parked cars and inviting "dooring" collisions and unsafe passing) may feel more comfortable.

Installing R117 (CA) PASS [BIKES] 3 FT MIN signs would inform all roadway users that bicyclists are expected on-street, and would inform motorists of the desired safety behavior (i.e., passing with wide clearance)—in this context arguably more clearly than R4-11 [BIKES] MAY USE FULL LANE signs.

The north sidewalk is narrow and obstructed by utility poles. The City is pursuing utility undergrounding, which would improve usability of the north sidewalk for both pedestrians and bicyclists. However, the sidewalk is not a suitable bicycle accommodation. Sidewalk bicyclists can be hidden from motorists turning into driveways and north-side streets.

School Street has a double yellow (no passing) centerline, implemented with yellow raised reflectors (i.e., no paint, thermoplastic or tape markings). In the short term, consideration could be given to removing the centerline to encourage motorists to reduce speed by modestly increasing uncertainty with respect to oncoming traffic, and to pass bicyclists with greater clearance. It is expected that passing opportunities will be less frequent during congested school arrival and dismissal periods, but many motorist-bicyclist interactions occur during off-peak times.

MUTCD section 3B.01 Yellow Center Line Pavement Markings and Warrants requires centerline only on paved urban arterials and collectors at least 20' wide with daily vehicle volume (ADT) of 6,000 or greater, and suggests centerline on such streets when ADT is 4,000 or greater.

A better way to improve the safety and comfort of bicycling on this segment, and to reduce vehicle-bicycle conflicts, would be to convert the north-side parking lane to a two-way cycle track. This 1,000' bikeway gap closure would connect the two-way shared-use path environments of First Street and the Regional Trail, creating a continuous off-street route to the south edge of the Mt. Diablo Road commercial corridor. There is parking capacity near the corner on the two streets that intersect from the north (Avalon Court and Paradise Court) and the five north-side house driveways on School Street are each wide and deep enough to park at least two vehicles.

Avalon Avenue / Avalon Court

Avalon Avenue intersects School Street from the south just west of where Avalon Court (dead end) intersects from the north. As shown in Figure 4-14(a), the STOP controlled crosswalk across Avalon Avenue and the uncontrolled crosswalk across School Street between the two intersecting streets are both marked with two yellow lines. Avalon Court has no STOP or YIELD sign, and no crosswalk marking. Single-sided school crosswalk warning sign assemblies (S1-1 School

Pentagon + W16-7p Downward Pointing Arrow plaque) are posted behind the sidewalk on both sides of the School Street crosswalk.

a) Existing b) Concept

Figure 4-14: School Street intersection with Avalon Avenue and Avalon Court

High-visibility markings are suggested at all uncontrolled crosswalks (such as those crossing School Street) to improve motorist awareness and yielding.

As noted above, many bicyclists traveling between First Street and the Regional Trail currently use the north sidewalk. This is a less-than-ideal safety and accessibility condition on this street for travel between the Trail and the elementary school, downtown, and BART. Until a safer and more appropriate bikeway is implemented along School Street, it is suggested to enhance the crosswalks across Avalon Court and Paradise Court with high-visibility markings, as is the case at the STOP controlled crosswalk across First Street. In addition, installing a STOP sign and word marking on Avalon Court and Paradise Court would remind motorists to check for bicyclists on the street and sidewalk.

To improve visibility of the crosswalk warning sign assemblies at the Avalon intersection, they could be installed in the parking lane on simple round islands. A standard-size warning sign can be protected from vehicle impacts by a 5-foot island, which will not affect drainage if installed 2 feet from the curb (i.e., projecting 7 feet into the street). For even more motorist awareness, warning sign assemblies can be made double-sided so both approaches see a pair of signs. These two improvements are general citywide suggestions.

Figure 4-14(b) shows the combined concept.

Paradise Court

At Paradise Court, the uncontrolled crosswalk on the west leg has high visibility markings. The north crosswalk is unmarked. Paradise Court has no STOP or YIELD sign.

The east-facing 1-sided crosswalk warning sign near the northwest corner is not near the crosswalk; it is suggested to move it to the corner to clearly indicate the crossing location. The west-facing 1-sided sign at the south end is properly located at the crosswalk.

As at Avalon, it is suggested to make both warning signs double-sided, and to consider installing them on floating islands in the parking lane to improve motorist awareness and provide a bit more protection for pedestrians. A small center island or painted area with a R1-6 Yield To Pedestrians In Crosswalk "flipper" sign could further cue motorist yielding.

Figure 4-15: School Street crosswalk at Paradise Court / Stanley MS - existing

Stanley Middle School frontage

A long painted walkway along the south curb connects the sidewalk at Paradise Court with the continuation east of Stanley Middle School's three driveways. Installing two long narrow islands on the street side of the walkway across the parking lot's two tree islands would protect pedestrians from through and turning traffic.

Where School Street curves at the Regional Trail access, there is ample width for a bicycle left turn pocket protected by islands, on which warning sign assemblies could be installed.

Figure 4-16 illustrates the combined concept.

Figure 4-16: Concept for Paradise Court and Stanley Middle School frontage

Topper Lane

At Topper Court, just south of the Regional Trail access point, School Street becomes Topper Lane, which continues south approximately 1,000' to its T-intersection with St. Mary's Road. There are 12 fronting houses—10 on the west side and 2 on the east side. The paved width is 22' and un-curbed. Some west-side houses have front parking areas on which vehicles can be mostly positioned off-street. The posted speed limit is 25 mph. Just south of the bend by Topper Court there is one speed hump with a 15 mph warning sign.

Figure 4-17: Topper Lane, facing north toward Stanley Middle School

Topper Lane is used by students walking and bicycling to school from houses along it and those on Birdhaven Court, which intersects St. Mary's approximately 170' to the east and has no connection to the Regional Trail, unlike streets further east (Hope Lane and its connecting streets, Broadmoor Court, Santa Maria Way, and Las Huertas Road).

Topper has no sidewalks. As with any unmarked two-way street that is 20'-24' wide, motorists typically assume that they can operate independently on their half width, and shift left to pass walkers and bicyclists with safe clearance. However, such passing is delayed or impeded by oncoming traffic, which can be uncomfortable for pedestrians on either side. Two options were considered for improving walking and bicycling conditions on Topper Lane:

Table 4-5: Options considered for Topper Lane

#	Option	Vehicle access	Details
a	One-way end to end	Enter one end, exit the other Also one-way internally	Signs: Do Not Enter (Except BIKES) at one end Optional "half-closure" barrier at other end, permeable to bicycles Within block: 10' center lane, 6' right shoulders (white stripes), 6' oncoming bike lane (double yellow line, dashed on bicycle side) Bicyclists: Motor traffic direction: use right shoulder Other direction: legal "contraflow" bike lane, also usable by pedestrians Pedestrians: Use right shoulder or other-side bike lane, in either direction
b	Two-way Edge Lane Road	Enter & exit either end	Striping: 10' centered lane, 6' "edge lanes" (dashed lines, optional color). Transition to 2-way layout at each end. Signs: Special signs at each entry directing motorists to use the center lane except to pass oncoming traffic on the right using the edge lane while yielding to users there Motorists: Use center lane if no oncoming traffic. If oncoming traffic, use edge lane after yielding to users ahead Pedestrians: Walk in edge lane in either direction Bicyclists: Ride in edge lane in conventional direction on their side of streets

Option (a) would create a one-way block for both through traffic and block residents, with striped shoulders useable by pedestrians and bicycles. The single lane would be centered and could be just 10' wide, enabling striping of 6' areas on either side. The left-side stripe (from the motorist perspective) would be a double yellow centerline with a solid line adjacent to motor traffic and a dashed line on the far side. This would legally enable one-way bicycle operation in the opposite (so-called "contraflow") direction. The dashed yellow line would legally enable bicyclists to pass across the yellow line when safe, for example to overtake pedestrians or slower bicycles.

A full-time one-way Topper Lane could be northbound-only or southbound-only for motor traffic. Northbound would place student drop-offs on the north side of School Street (good for Lafayette Elementary, not good for Stanley Middle School) and would intensify the westbound left turn onto southbound Avalon Avenue for motorists returning to St. Mary's Road. Southbound would place drop-offs on the south side of School—good for Stanley, not as good for Lafayette Elementary, but possibly more compatible with First Street being one-way southbound because it would create predominantly eastbound vehicle circulation between Avalon and Topper.

Two other one-way alternatives were considered—"time of day" operation (i.e., one-way only during school commute periods), and making one endpoint (perhaps the St. Mary's intersection) two-way so residents of the block and their visitors could enter and exit there while through traffic was restricted to one-way. Neither variant was pursued because they both would preclude marking shoulders for pedestrian and bicycle use.

Option (b), the Edge Lane Road treatment, is relatively new to North America but has a long successful track record on low-volume low-to-moderate speed roads in northern Europe. Motor traffic shares a center lane that has dashed edge lines and no centerline. Pedestrians and

bicyclists use the "edge lanes" (a.k.a. "advisory shoulders" / "advisory bike lanes"), which may optionally be colored. Depending on volume and speed, the center lane can be as narrow as 10' —typically the narrowest on North American streets, which would create 6' edge lanes.

If there are no oncoming vehicles, motorists drive in the center lane. When there is an oncoming vehicle, both motorists encroach into the edge lanes, yielding to (i.e., slowing and staying behind) nonmotorized traffic until they can shift back into the center lane.

ELRs are not yet a U.S. standard but can be installed under a California MUTCD Request To Experiment. The website https://www.advisorybikelanes.com/, maintained by traffic engineer Michael Williams, contains descriptions, images, videos, and links to design documents such as FHWA's *Small Town and Rural Multimodal Networks* (2016), which has a chapter on the treatment.

Topper Lane's low speed, good sight-lines and low volume would appear to make the ELR treatment worth considering. However, if peak congestion on School Street or at the Topper / St. Mary's intersection backed up traffic onto Topper, both shoulders could become blocked by vehicles, which would negate the ELR's benefits for pedestrians and bicyclists. For this reason, one-way option (a) is suggested for further development, and southbound is favored.

Figure 4-18 (drawn in Streetmix) illustrates the concept, facing south (toward St. Mary's). Non-motorized areas are colored green for emphasis—the pavement color is not essential. Pedestrians traveling north and south would also use both. Note that the left-side 6' area is adjacent to the landscape strip along the backyard walls of houses on the west side of Birdhaven Court, which are several feet deep and walkable in some segments. Minor cleanup of that strip would provide more comfortable width for east-side walkers. Note also that the right-side 6' area is along houses, many of which have unpaved front parking areas parallel to the street. Those areas, when empty, also provide extra width for pedestrians.

In actual operation it would be expected that motorists would sometimes want to shift a few feet left across the yellow "centerline" separator when there was no oncoming traffic, in order to give right-side pedestrians and bicyclists more passing clearance. Consideration could be given to legalizing this maneuver by making the centerline dashed-yellow instead of solid+dashed.

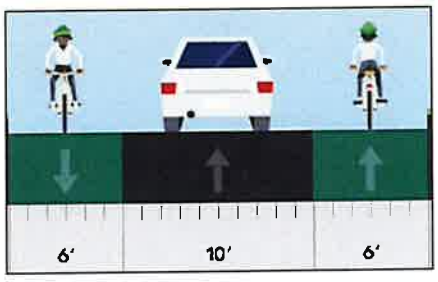


Figure 4-18: Topper Lane one-way southbound concept

Summary of suggestions (School Street and Topper Lane)

Table 4-6: Suggestions for School Street and Topper Lane

#	Location	Item	Suggestion
1	First Street intersection	No Left Turn sign obscured	Trim back vegetation and maintain
2		Do Not Enter - orientation	Consider angling left sign a bit eastward and right sign a bit westward, toward approaching traffic
3		Do Not Enter - condition	Replace if faded
4		Parking at west crosswalk	Prohibit parking 1 car length upstream
5	Avalon Ave/Ct intersection	Uncontrolled crosswalk visibility	Add high visibility markings
6		Warning sign visibility	a) Consider moving signs onto small islands b) Consider marking signs double-sided
7		North crosswalk	Install high visibility markings (Trail connector)
8		Avalon Ct approach	Install STOP sign and word marking
9	Paradise Ct intersection	Paradise Ct approach	Install STOP sign and word marking
10		North-side warning sign	Move eastward to crosswalk location
11		North crosswalk	Install high visibility markings (Trail connector)
12		Warning sign visibility	a) Consider moving signs onto small islands b) Consider marking signs double-sided
13		West crosswalk visibility	Consider R1-6 Yield To Peds In Crosswalk sign
14	Stanley MS frontage	South side painted walkway	Protect with narrow islands between driveways
15		Trail access point	a) Consider installing EB bike left turn pocket b) Consider installing mid-block crosswalk protected by islands, with warning signs
16	Topper Lane	No pedestrian facilities No striped or separated bikeways	Consider making street one-way southbound between Topper Court and St. Mary's Road, with one 10' centered lane, a 6' right (west) shoulder and 6' left (east-side) "contraflow" bike lane / shoulder
17	School St	North side between First Street and Regional Trail access point	Consider replacing the parking lane with a two-way cycle track

4.4.2. Area #2: Vicinity of Springhill Elementary School and Acalanes High School

Overview

Springhill Elementary School and Acalanes High School are located in the east central area of Lafayette just north of the Highway 24 freeway and BART line, as shown in Figure 4-19. Both schools' attendance boundaries extend well beyond the edges of the figure.

Pleasant Hill Road is an arterial and commuter route that connects eastern Lafayette with Highway 24 and extends north through the city of Pleasant Hill.

Figure 4-19: Springhill Elementary School and Acalanes High School – context

This section has three subsections:

- Intersection of Pleasant Hill Road, Deer Hill Road and Stanley Boulevard
- Intersection of Pleasant Hill Road, Springhill Road, Quandt Road and Hillview Lane
- Intersection of Springhill Road and San Reliez Court

Pleasant Hill Rd / Deer Hill Rd / Stanley Blvd

Existing conditions

Pleasant Hill Road intersects Deer Hill Road and Stanley Boulevard at a signal approximately 900' north of the Highway 24 interchange. Acalanes High School occupies the northeast quadrant; a Shell station occupies the southeast corner. A fenced and gated parking lot occupies the northwest corner; at the time of the site visit it had no sign indicating its ownership or use. The Lafayette Ridge recreation area occupies the west side of Pleasant Hill north of Deer Hill. Its staging area / parking lot is approximately 1,600' north of Deer Hill Road.

Deer Hill Road ascends a substantial hill west of Pleasant Hill Road. Sienna Ranch ("Nature Connection - Camps, Classes & Events") is located on the north side approximately 300' west of the signal, and the hill's crest is approximately 500' further west. The area between Deer Hill Road and the freeway is currently undeveloped.

Figure 4-20: Pleasant Hill Rd / Deer Hill Rd / Stanley Blvd intersection

Two-line yellow (school) crosswalks are marked on the west (Deer Hill), east (Stanley) and south (Pleasant Hill) legs. The north leg crosswalk is not marked. No advance limit lines are present. The northeast, southeast and southwest corners have single 45-degree curb ramps. The north end of the west crosswalk has a directional ramp.

Planned and proposed conditions

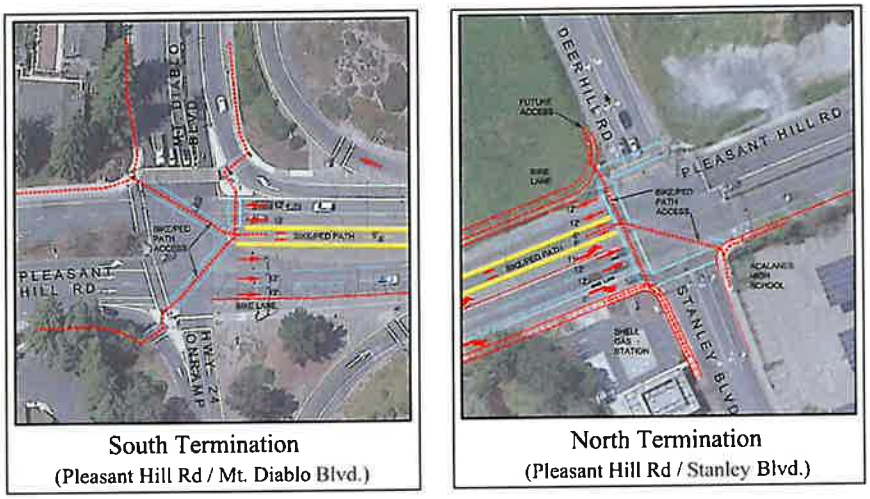
City staff said that substantial residential development was planned along Deer Hill, which would substantially increase vehicle trips through the intersection and may increase attendance at the high school and elementary school.

Acalanes High School's attendance area extends south of Highway 24. There is a continuous pedestrian route (sidewalks and crosswalks) on the east side of Pleasant Hill Road between the school and the Mount Diablo Road signal just south of the Highway 24 / Pleasant Hill Road interchange, 2,300' (0.44 miles) south of Stanley Boulevard.

There is currently no bicycle connection through the interchange suitable for high school-age students. The interchange is a full cloverleaf (Caltrans Local Street Interchange Type L-10) with high-speed free-flowing loop ramps on all four quadrants. Current bicycle accommodation through the interchange is a mix of conventional unbuffered bike lanes, parking lanes, and wide outside lanes.

The nonprofit group Safe Route to Acalanes High School is developing a concept for a center-running two-way cycle track that would connect bicyclists through Pleasant Hill Road's interchange with Highway 24. Its endpoints would be the signals to the south and north, at Mount Diablo Boulevard and Deer Hill / Stanley respectively. Figure 4-21 shows the concept figures for the center-to-outside bicycle movements at the two signals.

Additional information and graphics on the concept can be found at https://www.saferouteto.org/.



South Termination
(Pleasant Hill Rd / Mt. Diablo Blvd.)

North Termination
(Pleasant Hill Rd / Stanley Blvd.)

Figure 4-21: Safe Route to Acalanes HS – concept for centered bikeway under CA-24

Observations

The evaluator walked all three marked crosswalks in both directions, measuring the height of the pedestrian buttons and noting their type, orientation, and reachability from the closest position that a wheelchair user might use.

As shown in Table 4-7, two pedestrian buttons are older small types that are hard to press for persons with limited strength or without the use of their fingers. The button serving the west end of the south crosswalk is not reachable from the paved sidewalk because there is an unpaved gap between the corner and the mast arm pole. It is suggested to pave the missing area. The button serving the north end of the west crosswalk is reachable by an able-bodied person but would be usable by all if mounted on an extender bracket (Figure 4-26(b)).

Table 4-7: Pedestrian Buttons - Pleasant Hill Rd at Deer Hill Rd / Stanley Blvd

		Button				
Crosswalk	**Corner**	**Location**	**Facing**	**Convenient**	**Height**	**Type**
E	NE	Small signal pole	W	Yes	OK	Large (OK)
	SE	Mast arm pole	W	Yes	OK	**Small**
S	SE	Small signal pole	N	Yes	OK	Large
	SW	Mast arm pole	N	**No**	OK	Large
W	SW	Small signal pole	E	Yes	OK	**Small**
	NW	Mast arm pole	E	**Partial**	OK	Large

Analysis

The center-running cycle track concept is interesting in that it would provide a fully-separated bikeway between the signals north and south of the interchange. Connecting bicyclists to and from the center bikeway may require an exclusive signal phase and site-specific markings (such as diagonal crossings) and signage.

Another option for a mostly-separated bikeway could be considered. The east sidewalk through the interchange and between its north end and Stanley Boulevard was widened sufficiently for a shared-use path or a sidewalk adjacent to a two-way cycle track (Figure 4-22). In addition to the crosswalks at the endpoint signals (#1, #6), this alignment would have three conflict areas at the interchange ramps (#2, #3, #4) and a simple one at the STOP-controlled, right-turn-out-only T-intersection of Acalanes Avenue. One connectivity advantage of this concept relative to a centered path is that Acalanes Avenue provides access to many local streets whose residents could then walk and bike to destinations south of the freeway.

Figure 4-22: Concept for east-side cycle track or shared use path through interchange

Because the interchange is currently an old-style full cloverleaf (Caltrans Type L-10), the three ramp conflicts all involve uncontrolled motor traffic and relatively large-radius ramps. A common modification of such interchange ramps to improve conditions for pedestrians and bicyclists is to "square up" the junctions, producing low vehicle speeds at the conflict areas, and add traffic signals. What results is a Type L-9 Partial Cloverleaf. At this interchange, the southwest loop ramp (conflict #2) could be squared up closer to the Mt. Diablo Boulevard leg, and the northeast loop and diagonal ramps (conflicts #3 and #4) could be squared up together and signalized at a point between their current junctions, producing a simple controlled-crosswalk conflict area.

An alternate approach to the northeast ramp conflicts (#3 & #4) would be to grade-separate the path under both the loop and diagonal ramps via an undercrossing. This was implemented, for example, at Sacramento County's US-50 / Watt Avenue interchange, which has a fully grade-separated shared-used path on its east side. However, there the local street (Watt) crosses over the freeway.

Figure 4-23: US-50 / Watt Avenue interchange – fully grade-separated path

An excellent Caltrans resource for exploring interchange transformation options is the its 2010 publication *Complete Intersections: A Guide to Reconstructing Intersections and Interchanges for Bicyclists and Pedestrians*. Chapter 2 lays out general principles, and Chapter 9 covers interchanges and possible modifications to ramp crossings.

Summary of suggestions (Pleasant Hill Rd / Deer Hill Rd / Stanley Blvd)

Table 4-8: Suggestions for Pleasant Hill Rd at Deer Hill Rd / Stanley Blvd

#	Location	Item	Suggestion
1	Approaches	Approaches with marked crosswalks	a) Install advance limit lines 4' before crosswalks
			b) Ensure adequate crossing time
			c) Consider time-of-day pedestrian recall
			d) Consider Leading Pedestrian Interval phasing
2	SE corner	Button serving east crosswalk	Replace with large low-actuation-force type
3	SW corner	Button serving south crosswalk	Extend sidewalk to mast arm pole
4	NW corner	Button serving west crosswalk	Install button extender bracket for easier reach
5	Corridor between signals	Options for partly separated bikeway and reduced pedestrian crossing conflicts	Consider an east-side shared use path or sidewalk + cycle track combination, involving "squaring up" and signalizing the ramps to replace uncontrolled high-speed conflicts with controlled junctions and low-speed turns.

Observations (Pleasant Hill Rd / Springhill Rd / Quandt Rd)

Pleasant Hill Road intersects Springhill and Quandt just east of Springhill Elementary. Just east of the main intersection, Hillview Lane (a private road with no outlet) intersects Quandt from the south. Springhill, Quandt and Hillview are two-lane streets. On the southwest corner, a right turn slip lane connects to southbound Pleasant Hill.

Sidewalks are present on both sides of Pleasant Hill Road north of the intersection, on the south side of Springhill Road, on both sides of Quandt Road, and along the west side of Hillview Lane for approximately 150 feet (continuing for approximately 475 feet as a painted walkway before continuing south as the east sidewalk of Pleasant Hill Road.

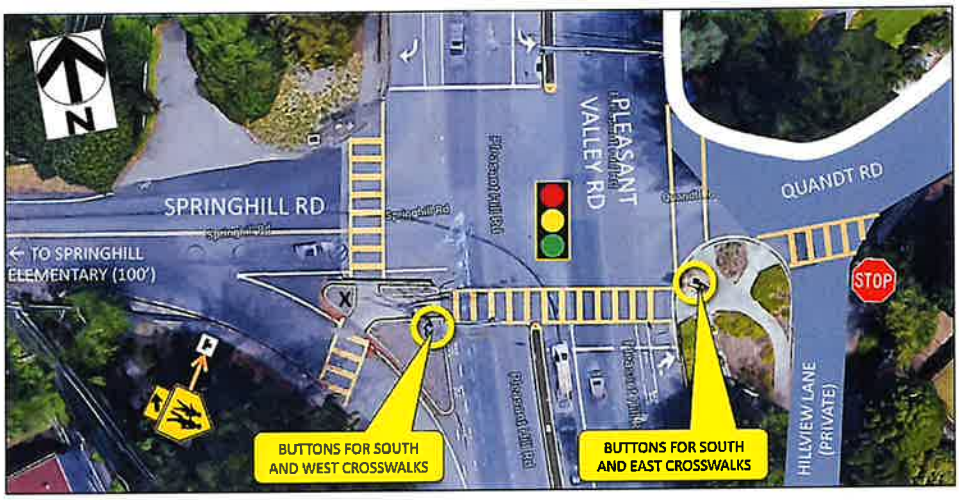


Figure 4-24: Pleasant Hill Rd / Springhill Rd / Quandt Rd intersection

High-visibility yellow (school) crosswalks are marked across the west leg, south leg and right turn slip lane of the main intersection, and across Hillview Lane. The main intersection's east leg is marked with two yellow lines. The north leg is not marked. A crossing guard operates this intersection before and after school during the school year.

Slip lane crosswalk

Figure 4-25: Eastbound-southbound slip lane crosswalk and warning sign

An advance S1-1 School Pentagon is installed just east of Springhill Elementary's east driveway, near where the slip lane becomes visible. A School Crosswalk Warning Assembly B sign is installed on the outside of the slip lane at the gore point (Figure 4-25).

To improve visibility of the slip lane crosswalk and awareness of its location, it is suggested to:

- Move the Assembly B sign to the actual crosswalk location
- Add a second Assembly B sign ("mirrored" so walkers and arrow face rightward) on the left (island) side of the crosswalk. This will become visible before the right-side sign.
- Add a Yield Line ("shark's teeth") marking in advance of the crosswalk
- Consider adding a YIELD word marking in advance of the Yield Line
- Consider a raised crosswalk (crosswalk markings on a flat-top speed table)

Consideration could also be given to replacing the slip lane with a right-angle urban-style junction, requiring that turns onto southbound Pleasant Hill Road be made slowly.

West crosswalk

The channelization island is composed of three small islands with street-grade walkways in between. Buttons for the west and south crosswalks are mounted on the mast arm pole next to Pleasant Hill, far from the west crosswalk. A slow pedestrian wanting to cross northbound—such as someone with reduced mobility, or pushing a stroller and escorting a small child, may not have enough time after pressing the button to cross Springhill. It is suggested to add a separate button where a pedestrian would wait to cross northbound (black "**X**" in the leftmost island in Figure 4-24).

East crosswalk

The pedestrian call buttons on the southeast corner are mounted on the signal pole. The button serving the east crosswalk is on the west (Pleasant Hill Road) side of the pole, inaccessible to mobility-impaired pedestrians on the east side, i.e., at the south end of the east crosswalk. It is suggested to relocate that button, either to a separate post and button on the east side of that waiting area, or a "button extender" (a.k.a. "extension bracket") on the east face of the pole.

The button is a small type requiring high actuation force. It is suggested to replace it with a large low-force button.

Hillview Lane

Hillview intersects Quandt from the south just east of the main intersection. It has a STOP sign and a high-visibility crosswalk. The walking route to the High School consists of Hillview's west-side sidewalk (~150') and painted walkway (~475'), and Pleasant Hill's east sidewalk.

To improve motorist awareness, consider adding a STOP word marking and advance limit line.

a) Existing button location

b) Button extension/extender bracket

Figure 4-26: Southeast corner pedestrian buttons

Summary of suggestions (Pleasant Hill Rd / Springhill Rd / Quandt Rd)

Table 4-9: Suggestions for Pleasant Hill Rd at Springhill Rd / Quant Rd

#	Location	Item	Suggestion
1	All crosswalks	Detectable warnings	Install detectable warning strips
2		Advance limit lines	Add on signal- and STOP- controlled approaches
3		Crossing time	Use 2.8 feet per second crossing speed (elementary-age)
4		Pedestrian recall	Provide time-of-day pedestrian recall
5		Leading Ped. Interval	Provide
6	West crosswalk	South-end button	Button is on mast arm pole, far from crosswalk. Add separate post next to west side of crosswalk.
7	SW corner slip lane crosswalk	Signs	a) Relocate School Crossing Assembly B sign to crosswalk (to indicate actual location) b) Add left-side School Crossing Assembly B sign
8		Markings	Add Yield Line (shark's teeth) marking
9		Crosswalk profile	Consider raised crosswalk
10		Need	Consider replacing the slip lane with a conventional right-angle right turn
11	SE corner	Button for NB crossing of Quandt	a) Button on west side of pole is not accessible. Consider extension bracket on east side of pole, or a separate post. b) Replace small button with large-face easily-pressed type.
12	Hillview Lane	Approach to Quandt	Add STOP word marking and advance limit line

Observations (Springhill Rd / San Reliez Ct)

Springhill Road intersects San Reliez Court (private road) at a 4-way intersection with 2-way STOP control less than 150 feet west of Springhill Elementary's west driveway. Springhill has a

sidewalk on the south (school) side between the intersection and the school, and on the north side to the west extending 2,300' (0.45 miles) to Black Hawk Road. The school walking route crosses Springhill on the uncontrolled west crosswalk and San Reliez on the STOP-controlled crosswalk, both of which have high-visibility markings.

a) EB approach. Walking route crosses from north side to south.

b) Aerial showing walking route and STOP sign on San Reliez

c) San Reliez NB approach – STOP sign hidden by tree

d) San Reliez STOP sign

Figure 4-27: Springhill Rd / San Reliez Ct intersection

Springhill Road has school warning sign assemblies properly located at the west crosswalk. The north-side sign is single-sided, facing the westbound approach. The south-side sign is double-sided. It is suggested to make the north-side sign double-sided to improve visibility for eastbound drivers.

A R1-6 in-street Yield To Pedestrians In Crosswalk sign is installed on the double-yellow (no passing) centerline on the west side of the west crosswalk. Consider forking the centerline around the sign to raise motorist awareness and hopefully reduce the incidence of vehicles impacting the sign.

Detectable warning strips are installed at both ends of each marked crosswalk. Advance school warning signs are installed upstream on the westbound and eastbound approaches.

The tree and hedge on the east side hide the STOP sign on the northbound approach of San Reliez Court and the hedge also hides the sidewalk. The vegetation should be trimmed and maintained, and the STOP sign possibly relocated for visibility.

The northbound approach currently has no STOP word marking and no advance limit line. Consider adding both.

There appears to be sufficient width along south-side house frontage to add a sidewalk between San Reliez Court and Marino Road. This would enable residents of many more homes on Marino to travel to/from the school without crossing Springhill Road twice in each direction.

Summary of suggestions (Springhill Rd / San Reliez Ct)

Table 4-10: Suggestions for Springhill Road at San Reliez Court

#	Location	Item	Suggestion
1	West crosswalk	North-side warning sign assembly	Make double-sided, for earlier visibility to eastbound traffic
2		In-street R1-6 Yield To Pedestrians In Crosswalk sign	Consider forking double yellow centerline around sign to improve motorist awareness, extending sign longevity by reducing vehicle impacts
3	San Reliez Court, south leg (NB approach)	STOP sign visibility	STOP sign is hidden by vegetation. Trim and maintain vegetation, and/or relocate sign.
4		Markings	a) Consider installing STOP word marking b) Consider installing advance limit line (typical)
5		Sidewalk	Consider adding, especially on south leg
6	Springhill Road	Sidewalk	Add on south side to Martino Road

4.4.3. Area #3: Vicinity of Burton Valley Elementary School

Existing conditions

Burton Valley Elementary School is located on a hill in southeastern Lafayette, north of Rohrer Drive, west of Merriewood Drive, east of St. Mary's Road and south of Sandalwood Court. As shown in Figure 4-28, the school's attendance boundary extends north to Highway 24 and east and south to the city limits. The blue rectangle indicates the area included in Figure 4-29.

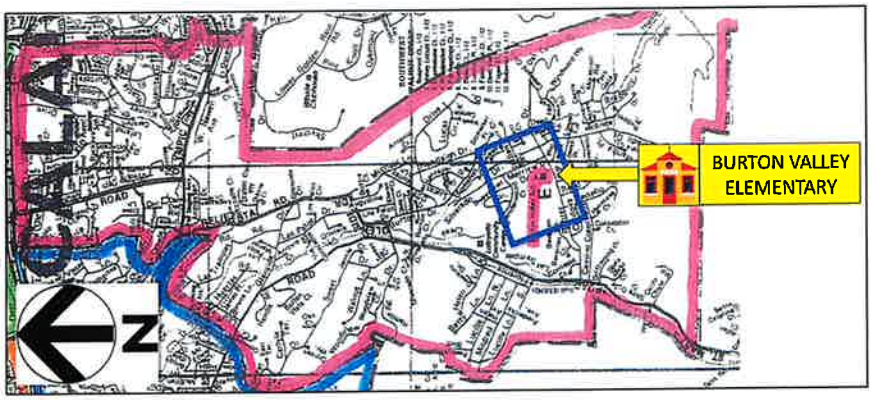


Figure 4-28: Burton Valley Elementary attendance boundary

As shown in Figure 4-29, the school has three entrances, each discussed in a subsection below:

- Merriewood Drive between Indian Way and Sandalwood: 2-way driveway
- Rohrer Drive (2-way driveway near Warwick Court. Exit-only driveway near Reed Drive)
- Pedestrian-bicycle path to Sandalwood near Sweetwater Circle (green arrow)

Figure 4-29: Burton Valley Elementary vicinity and 3 access points

Existing conditions (Merriewood Drive access)

This section will use the convention that Merriewood and Silverado run north-south and Sandalwood, Indian Way and the school driveway run east-west.

Figure 4-30: Merriewood Drive access vicinity

Except for Sandalwood Circle and the school driveway serving Merriewood Drive, no streets shown in Figure 4-30 have sidewalks. Merriewood, Silverado and Indian Way are 36' wide streets with 8' striped parking shoulders, two 10' travel lanes, and a double yellow centerline.

STOP signs are installed on the school driveway at Merriewood and on Indian Way at Silverado (west and east legs). Uncontrolled crosswalks with high-visibility yellow (school) markings are present across Merriewood just north of the school driveway and across Silverado at its intersection with Indian Way. Two-line yellow (school) markings are installed across Sandalwood Court and Indian Way at Merriewood (T intersections, implied YIELD), and across Indian Way's STOP-controlled east and west legs at Silverado.

The marked crosswalk across Merriewood at the school driveway has three warning signs—a two-sided R1-6 In-Street Yield To Pedestrians In Crosswalk sign on the centerline approximately 6' north of the crosswalk, and two single-sided S1-1 School Pentagon + W16-7p Downward Pointing Arrow assemblies facing approaching traffic. The north-facing assembly is installed at the crosswalk. The south-facing assembly is installed some distance upstream near the lot line between houses, so its downward arrow does not indicate the crosswalk location.

There is also an older-style single-sided school crosswalk warning assembly on the north side of Indian Way at its (implied YIELD-controlled) crosswalk at Merriewood, consisting of a Caltrans Traffic Manual W65 School Pentagon sign with crosswalk lines above a W66A SCHOOL XING plaque.

Merriewood and Silverado between Rohrer and the Somerset Drive / Burton Drive intersection are also a "last mile / first mile" connection to the Lafayette-Moraga Regional Trail via the access point on Silverado just south of that intersection. The Trail connects the neighborhood to the middle school, downtown Lafayette and the BART station.

City staff said that a crossing guard operates the crosswalk on Merriewood at the driveway. During the summer of 2020 an 11-year old bicyclist died after descending the steep driveway and failing to stop at the STOP sign. Similar downhill speeds have been noted as concerns on Sandalwood Court's approach to Merriewood.

Observations (Merriewood Drive access)

Pedestrian and bicyclist behavior

Adult and child pedestrians were observed walking in the parking shoulders where no vehicles were parked. They continued around parked cars by either walking on the edge of adjacent yards or in the street. Pedestrians did not always walk facing traffic, and some were reading.

a) Walkers in parking shoulders

b) Youth biking north in west shoulder (against traffic)

c) 2 youths crossing after using east shoulder in legal direction

d) 2 youths walking bikes around parked car after riding in legal direction in west shoulder

e) Crossing guard, parent, child, stroller, traffic

f) Family walking together, Rohrer at Merriewood

Figure 4-31: Merriewood Drive observations

Bicyclists used the travel lanes or rode in the shoulders and merged into the street around parked vehicles. Youth bicyclists tended toward the latter behavior. Some youths dismounted at parked

vehicles and walked their bicycles around on the edge of the adjacent yard. Some youth bicyclists turned left from the right shoulder without merging or checking for traffic behind.

Note that these observations were conducted at midday on a weekday during the Covid-19 pandemic. A neighborhood resident notes that pedestrians cross the street frequently to remain socially-distanced.

Signs and markings

On Merriewood Drive near the school driveway, the south-facing school crosswalk warning sign assembly is not located at the crosswalk. It should be moved to the crosswalk, and upstream trees should be checked for sight-line blockage of the new location and trimmed if needed.

Passing should be discouraged near the crosswalk. A double-yellow (no passing) centerline is present for a short distance to the north. It is suggested to extend it further north, and to install double-yellow for 50' to the south of the school driveway.

It is a best practice to prohibit parking for at least one car length upstream of a crosswalk, to enable waiting pedestrians and approaching motorists to detect and react to each other. Red curb (no parking) is in place for one upstream car length on the west side of the crosswalk. On Merriewood and streets like it, where parking shoulders are used in lieu of sidewalks and bike lanes, it would be advisable to also prohibit parking for at least one car length *downstream*, because children—who may be short—may otherwise be hidden by downstream parkers.

Options for improving conditions for pedestrians and bicyclists

For both pedestrians and bicyclists who use the parking shoulders, having to merge into the traffic lane is error-prone and awkward, and having to walk along the edge of a yard to get around a parked car—especially with a bicycle—is also awkward. To address these issues, installing sidewalks first comes to mind. However, a 5' or 6' sidewalk would be too narrow for shared use by bicyclists, and if reserved for pedestrians, bicyclists would still use the parking shoulder and still need to merge into traffic or transition to/from the sidewalk get around parked vehicles.

In contrast, prohibiting parking on one side on certain segments—either full-time or during school commute periods—would provide an 8' wide path-like facility with sufficient width for shared use on a school commute route. Although path design guidelines recommend 10' minimum for two-way shared use, school commutes are basically unidirectional.

Staff said there seems to be some neighborhood momentum to consider parking restrictions for this purpose. One high-value segment for consideration is the west side of Merriewood south of the school driveway, to Indian Way (1 block) or Rohrer Drive (2 blocks). Consideration could be given to extending the configuration to the north, to Sandalwood Court (1 block), Silverado Drive (2 blocks), or along Silverado to the Regional Trail access point just south of Burton Drive.

Prohibiting parking on a given segment only during school commute periods could be considered. A "time of day" bike lane that becomes a parking lane during off-hours is somewhat comparable except that pedestrians typically use an adjacent sidewalk at all hours. Such a facility was formerly installed in Palo Alto on California Avenue north of Alma Street, a school commute route. The parking lane was 7' wide, but pedestrians had a sidewalk available at all times. That segment of California Avenue now has parking removed from one side and permanent bike lanes in both directions.

However, a time-of-day scheme would not provide benefits outside of school hours. As evidenced by the above mid-day observations when school was not in session, there is pedestrian and bicyclist demand at all times of day.

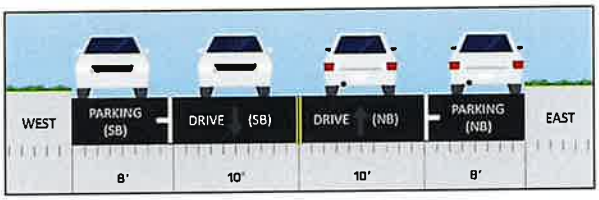
Two-block one-way concept for Merriewood, to add bike lanes and enable safer walking

A potential opportunity is present because both Merriewood and Silverado both convey two-way traffic between Rohrer Drive and the Merriewood/Silverado intersection.

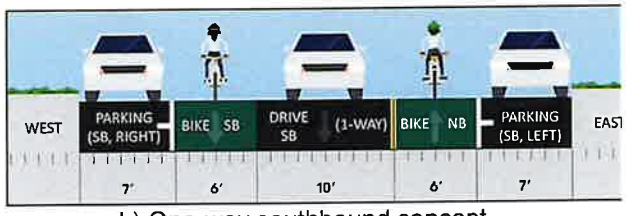
If Merriewood was made one-way southbound for motor traffic between Rohrer Drive and Sandalwood Court (2 blocks, 1,100'), the width of one travel lane could be reused to create a bike lane in each direction—the two blocks would remain two-way for bicycles.

Pedestrians would continue to walk in both directions in the parking shoulders, and could use the bike lanes to bypass parked vehicles.

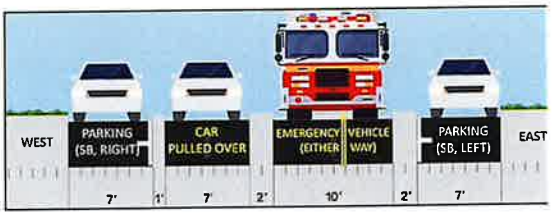
Parking would still be available on both sides of the street, but left-side parkers would cross an opposite-direction bike lane. This is similar to the one-block segment of Concord Avenue in Cambridge, MA between Waterhouse Street and Follen Street, which is one-way for motor traffic but two-way for bicycles. That configuration, including the left-side parking, works well due to low traffic speed and volume.



a) Existing two-way configuration



b) One-way southbound concept, normal operation



b) One-way southbound concept, emergency response

Figure 4-32: Merriewood Drive one-way concept

If the two-block one-way concept were implemented, the single vehicle lane at the school driveway crosswalk would reduce decision complexity because the only vehicle turning movements at the driveway would be the inbound and outbound left turns. If Merriewood was one-way southbound at the driveway, these turning movements would not cross, which could reduce drivers' decision complexity, and possibly also reduce delay.

West-side parking removal concept

The two-block one-way concept would still not provide pedestrians or bicyclists with a conflict-free space on the segments between intersections and the school driveway. Pedestrians would still need to travel in and out of the parking lane to pass parked vehicles. Parking movements would conflict with shoulder use for active transportation, as is currently the case. In addition, due to the street network's connectivity north of Sandalwood, extending the one-way concept to Burton Drive in order to connect to the Regional Trail access point may not be practical.

A more straightforward option that does not involve a one-way conversion would be to simply remove parking on the west side of Merriewood and Silverado between Rohrer and Burton. Most west-side homes have driveways, and most of which are two vehicles wide. Many driveways are two vehicles deep. Parking occupancy on the opposite side of the street is considerably less than 50%.

An in-street path on the west side would be on the correct side to serve the school driveway. The 8-foot width should accommodate higher-volume but mostly-unidirectional peak flows during school commute periods and lower-volume two-direction flows expected at other times. The facility would be available 24/7, and could connect the neighborhood to the Regional Trail access point.

Summary of suggestions (Merriewood Drive access)

Table 4-11: Suggestions for Merriewood Drive Access

#	Location	Item	Suggestion
1	Merriewood Drive crosswalk at school driveway (existing 2-way Merriewood configuration)	East-side warning sign assembly	a) Move from current upstream location to crosswalk. b) Make double-sided.
2		West-side warning sign assembly	Make double-sided
3		Centerline	Extend double-yellow (no passing) centerline 50' north of crosswalk and 50' south of driveway
4		Parking prohibition (for sight-lines)	Red-curb both sides of street at least 20' on both sides of the crosswalk.
5	Merriewood between Rohrer and Sandalwood	One-way southbound vehicular concept	Consider making Merriewood one-way northbound between Rohrer and Sandalwood, with a centered 10-foot travel lane, parking shoulders narrowed to 7 feet, and 6-foot bike lanes.
6	Merriewood and Silverado between Rohrer and Burton (Trail access point)	West-side parking lane conversion to shared use path	Consider repurposing the west-side parking shoulder as an 8-foot shared-use space.
7	School driveway to Merriewood	Cross section	Consider narrowing the vehicular portion of the driveway and shifting that width to its north sidewalk to create a two-way bikeway. Because the driveway is steep, bicyclists may still need to walk bikes uphill to the school.

Existing conditions (Rohrer Drive)

As shown in Figure 4-33, Burton Valley Elementary has two driveways on the north side of Rohrer Drive between its all-way-STOP T-intersections with Reed Drive and Merriewood Drive. The east driveway, approximately 70' west of Warwick Court and 250' west of Merriewood, is two-lane, two-way and has a sidewalk on its north/east side. The west driveway, approximately 100' east of Reed, is single-lane, exit-only and has a sidewalk on its west side.

Rohrer appears to be 34' wide on this segment, with two 10' travel lanes, parking shoulders (8' south, 6' north) and a centerline. Blue lines indicate segments with sidewalks. White lines indicate segments with parking shoulders and no sidewalks.

The STOP controlled crosswalks on the east leg at Reed and on the west and north legs at Merriewood have high-visibility yellow (school) markings.

A westbound bus stop and sign (County Connection Route 206) is on the north side opposite Warwick. A west-facing STOP AHEAD (W3-1) sign is opposite the east driveway.

City staff said that a team of crossing guards operates the crosswalks on Rohrer at Merriewood.

Figure 4-33: School access on Rohrer Drive between Reed Drive and Merriewood Drive

Observations

School was not in session during the site visit, so no informative vehicle, bicycle or pedestrian activity was observed.

Needs and opportunities

To access the school, pedestrians originating on the south side of Rohrer need crosswalks to reach the north side and continuous sidewalk to reach one of the two driveways. North-side sidewalk segments exist between the east-leg crosswalk at Reed and the west driveway's sidewalk, and between the west-leg crosswalk at Merriewood and the east driveway's sidewalk. Between the east and west driveway there is no north-side sidewalk, though there is a mostly-unused parking shoulder. South-side pedestrians close to Reed will likely walk to the crosswalk at Reed. Those originating at or east of Burnt Oak Circle will probably choose the east driveway

to avoid the uphill grade toward Reed, but will be unlikely to cross at Merriewood because there is no south sidewalk east of Warwick and the round-trip delay between the east driveway and Merriewood is approximately 2 minutes (250' = 1 minute at adult walking speed of 4.0 feet per second). For these pedestrians it would be useful to add an uncontrolled crosswalk between Warwick and the east driveway. Figure 4-34 shows a concept with the crosswalk located as close as possible to the driveway so the bus stop can remain in its current location.

A crossing guard could find this enhanced crosswalk fairly easy to control, especially if the school driveway's outbound lane was made right-turn-only at least at school commute times (the school's other driveway further west on Rohrer can serve turns in either direction).

At this and other crosswalks, in-street Yield To Pedestrian (R1-6) signs could be considered. One such sign is installed at the mid-block crosswalk on Sandalwood Court that serves the school's north-side path (Figure 4-36(a), (b)).

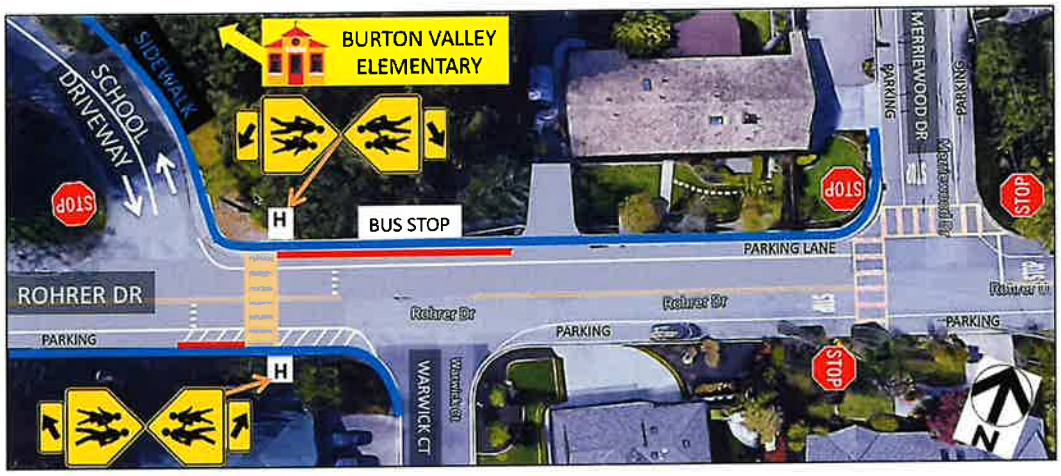


Figure 4-34: Rohrer Drive near Merriewood – crosswalk concept

No mid-block crosswalk is suggested near the west driveway because it is close enough to Reed that pedestrians are likely to walk round-trip to the controlled crosswalk there, and because an eastbound driver who runs the stop sign at Reed may not have sufficient stopping sight distance to the west driveway due to the crest vertical curve at Reed.

Summary of suggestions (Rohrer Drive)

Table 4-12: Suggestions for Rohrer Drive at school's East Driveway

#	Location	Item	Suggestion
1	Between east driveway and Warwick Court	Desired crossing location for south-side pedestrians originating east of Burnt Oak Circle	a) Install mid-block crosswalk with high-visibility yellow (school) markings. b) Install yield line ("shark's teeth") one car length upstream in both directions. c) Prohibit upstream parking for one car length on the south side and at the north side bus stop. Indicate with red curb, and with diagonal in-fill striping in the south side parking shoulder. d) Install school warning sign assemblies on the north and south sides at the crosswalk, preferably double-sided.
2	South side at east driveway	Existing W3-1 (STOP AHEAD) sign	Move further west (upstream) so it does not distract from the crosswalk warning signs.
3	Driveway approach	Turn restrictions	Consider making the driveway exit right turn only at least during school commute periods. (The school's exit-only driveway further west on Rohrer can serve turns in either direction.)
4	Crosswalk	In-street warning sign	Consider in-street Yield To Pedestrians (R1-6) signs mounted on the centerline. If there is concern about the sign being struck by vehicles, one option is to mount a socket at the centerline adjacent to the crosswalk so a crossing guard can install and remove a temporary sign.

Existing conditions (Sandalwood Court)

Burton Valley Elementary School's north access is a fenced shared use path between two house lots, connecting to Sandalwood Court just west of Sweetbrier Circle, at the crest of a hill. There is an uncontrolled mid-block crosswalk at the path. The crosswalk's sidewalk ramps extend into the street on curb extensions (bulb-outs) that each have white painted extensions one car length upstream.

Figure 4-35: Path connection to crest of Sandalwood Court

Single-sided warning sign assemblies are installed at curbside near the crosswalk, each consisting of a Caltrans Traffic Manual W65 (School Pentagon sign with crosswalk lines below) and a W66A SCHOOL XING plaque below. The east-facing sign assembly is located some distance upstream of the crosswalk. A R1-6 In-Street Yield To Pedestrians In Crosswalk sign is installed on the centerline at the crosswalk.

Three bollards are installed across the path entrance, with narrow spacing between. These may be intended to prevent motor vehicle access, or to slow bicyclists arriving at the sidewalk to deter them from riding into the street without checking.

Sandalwood also has an informal Regional Trail access point at the bottom of its hill to the west, accessed from a private "flag lot" driveway (#3142 Sandalwood). Consideration should be given to formalizing that pedestrian-bicycle connection with an access agreement.

Observations

School was not in session during the site visit, so no informative vehicle, bicycle or pedestrian activity was observed.

The narrow spacing between the bollards makes it awkward to walk a bicycle through, and would block a child bike trailer as well as long-tail and box-in-front family bicycle configurations.

a) Westbound approach & warning sign assembly

b) Facing south toward entrance

c) Path entrance (dark fence, bollards)

d) 3 bollards at entrance (dark, narrow spacing)

Figure 4-36: Sandalwood crosswalk and path

Needs and opportunities

Bollards at path entrance

Bollards across paths have the potential for incapacitating or fatal injuries to bicyclists. This occurs when two bicyclists approach in-line and the leader swerves and misses the bollard but the follower is impaled. The Federal Highway Administration (FHWA) recommends that bollards not be considered for path access control unless there is actual incidence of vehicle intrusion.

www.fhwa.dot.gov/environment/recreational_trails/guidance/accessibility_guidance/bollards_access.cfm

That said, deterring bicyclists—especially youths—from riding out into a street without slowing, checking for traffic, and safely yielding as needed is a valid concern. However, bollards are not the only option. A better one for a path entrance that cannot be widened (i.e., to insert a center island) is a "maze" consisting of two or more half-width fences or barriers, alternated between sides. The maze design should allow the operator of a "design bicycle" to traverse slowly without dismounting. "Design bicycles" used by families to transport schoolchildren include:

- "Long-tail" (extended wheelbase with a long rear rack for carrying kids and cargo)
- "Box bike" (long child/cargo carrier box in front of operator; small front wheel out front)
- Conventional single bike pulling a child trailer

Increasing visibility of crosswalk location

The crosswalk could be made more visible and its location detectable in more conditions, by:

- Moving the warning signs onto the curb extensions
- Making the signs double-sided
- Replacing the "SCHOOL XING" plaques with downward-pointing arrows
- Retroreflectorizing the sign posts
- Reflectorizing the entry end of the path fence

Connecting bicyclists to Merriewood Drive

Similar to the school's nearby driveway, Sandalwood Court is steep as it approaches Merriewood. Concerns exist about young bicyclists not stopping as they reach Merriewood.

Figure 4-37: Youth descending Sandalwood's west sidewalk toward Merriewood

Sandalwood is 36' wide between Sweetbrier Circle and Merriewood. Consideration could be given to prohibiting parking on one side and creating a two-way cycle track in the street (8' wide). Pedestrians would use the adjacent sidewalk. The remaining street width of 28' would provide two 10' travel lanes and 8' for other-side parking. There would be little or no width available for a traffic barrier along the cycle track; one separation option would be an asphalt dike with flexible delineators mounted on it. However, this would reduce the effective width of the cycle track because bicyclists would shy away from the dike and delineators, and they would also shy away from the curb along the sidewalk.

A south-side facility would eliminate parking for four houses and involve conflicts at their driveways. However, it would not require crossing Sandalwood or Sweetbrier.

A north-side facility would cross only one house driveway, and parking demand on that side is minimal or zero. However, users would need to cross Sandalwood at the crest and also cross Sweetbrier. However, sightlines are good at the crest and additional traffic calming could be considered there, such as a raised crosswalk.

Summary of suggestions (Sandalwood Court crosswalk)

Table 4-13: Suggestions for Sandalwood Court (PATH) Access

#	Item / Issue	Suggestion
1	Bollards at path entry	Remove bollards; replace with bike-safe alternative. Consider a "maze" with elements sized and spaced to allow slow traversal, without dismounting, of "design bicycles" such as long-tail and box-bike family configurations, and standard bikes towing child trailers. Brightly paint and reflectorize the maze elements.
2	Warning sign assemblies	a) Move sign posts onto curb extensions to improve visibility b) Make both signs double-sided c) Replace "SCHOOL XING" plaques with W16-7p Downward Pointing Arrow d) Install yellow retroreflective wraps or leading-side reflective strips, to make poles visible in headlights, to aid in locating the crosswalk.
3	Centerline	Install painted or thermoplastic double yellow (no passing) centerline for 50' on both sides of crosswalk, to deter passing. Existing raised pavement marker centerline is not sufficiently conspicuous for this purpose.
4	Yield lines	Add yield lines ("shark's teeth") one car length upstream on each approach.
5	Sweetbrier Circle	Install STOP sign and STOP word marking
6	Parking restriction	Red-curb one car length upstream on both approaches
7	Path visibility	Install retroreflectors on outside of ends of path fence, to make its location visible to approaching motorists in headlights.
8	Connecting bicyclists between the path and Merriewood	Consider removing parking on one side and installing an 8-foot two-way cycle track. (See discussion above for pros and cons of each side of the street.)

APPENDIX A: GLOSSARY OF PEDESTRIAN IMPROVEMENT MEASURES

Pedestrian Improvement Measures			
Measure	**Description**	**Benefits**	**Application**
Traffic Control Countermeasures			
Traffic Signal or All-Way Stop	Conventional traffic control devices with warrants for use based on the Manual on Uniform Control Devices (MUTCD).	Reduces pedestrian-vehicle conflicts and slows traffic speeds.	Must meet warrants based on traffic and pedestrian volumes; however, exceptions are possible based on demonstrated pedestrian safety concerns (collision history).
HAWK Beacon Signal	HAWKs (High Intensity Activated Crosswalks) are pedestrian-actuated signals that are a combination of a beacon flasher and a traffic control signal. When actuated, HAWK displays a yellow (warning) indication followed by a solid red light. During pedestrian clearance, the driver sees a flashing red “wig-wag” pattern until the clearance interval has ended and the signal goes dark.	Reduces pedestrian-vehicle conflicts and slows traffic speeds.	Useful in areas where it is difficult for pedestrians to find gaps in automobile traffic to cross safely, but where normal signal warrants are not satisfied. Appropriate for multi-lane roadways.
Overhead Flashing Beacons	Flashing amber lights are installed on overhead signs, in advance of the crosswalk or at the entrance to the crosswalk.	The blinking lights during pedestrian crossing times increase the number of drivers yielding for pedestrians and reduce pedestrian-vehicle conflicts. This measure can also improve conditions on multi-lane roadways.	Best used in places where motorists cannot see a traditional sign due to topography or other barriers.
Stutter Flash	The Overhead Flashing Beacon is enhanced by replacing the traditional slow flashing incandescent lamps with rapid flashing LED lamps. The beacons may be push-button activated or activated with pedestrian detection.	Initial studies suggest the stutter flash is very effective as measured by increased driver yielding behavior. Solar panels reduce energy costs associated with the device.	Appropriate for multi-lane roadways.

Pedestrian Improvement Measures			
Measure	**Description**	**Benefits**	**Application**
In-Roadway Warning Lights	Both sides of a crosswalk are lined with pavement markers, often containing an amber LED strobe light. The lights may be push-button activated or activated with pedestrian detection.	This measure provides a dynamic visual cue, and is increasingly effective in bad weather.	Best in locations with low bicycle ridership, as the raised markers present a hazard to bicyclists. May not be appropriate in areas with heavy winter weather due to high maintenance costs. May not be appropriate for locations with bright sunlight. The lights may cause confusion when pedestrians fail to activate them and/or when they falsely activate.
High-Visibility Signs and Markings	High-visibility markings include a family of crosswalk striping styles including the “ladder” and the “triple four.” One style, the zebra-style crosswalk pavement markings, were once popular in Europe, but have been phased out because the signal-controlled puffin is more effective (see notes). High-visibility fluorescent yellow green signs are made of the approved fluorescent yellow-green color and posted at crossings to increase the visibility of a pedestrian crossing ahead.	FHWA recently ended its approval process for the experimental use of fluorescent yellow crosswalk markings and found that they had no discernible benefit over white markings.	Beneficial in areas with high pedestrian activity, as near schools, and in areas where travel speeds are high and/or motorist visibility is low.
In-Street Pedestrian Crossing Signs	This measure involves posting regulatory pedestrian signage on lane edge lines and road centerlines. The In-Street Pedestrian Crossing sign may be used to remind road users of laws regarding right of way at an unsignalized pedestrian crossing. The legend STATE LAW may be shown at the top of the sign if applicable. The legends STOP FOR or YIELD TO may be used in conjunction with the appropriate symbol.	This measure is highly visible to motorists and has a positive impact on pedestrian safety at crosswalks.	Mid-block crosswalks, unsignalized intersections, low-speed areas, and two-lane roadways are ideal for this pedestrian treatment. The STOP FOR legend shall only be used in states where the state law specifically requires that a driver must stop for a pedestrian in a crosswalk.
Pedestrian Crossing Flags	Square flags of various colors, which are mounted on a stick and stored in sign-mounted holders on both side of the street at crossing locations; they are carried by pedestrians while crossing a roadway.	This measure makes pedestrians more visible to motorists.	Appropriate for mid-block and uncontrolled crosswalks with low visibility or poor sight distance.

Pedestrian Improvement Measures			
Measure	**Description**	**Benefits**	**Application**
Advanced Yield Lines	Standard white stop or yield limit lines are placed in advance of marked, uncontrolled crosswalks.	This measure increases the pedestrian's visibility to motorists, reduces the number of vehicles encroaching on the crosswalk, and improves general pedestrian conditions on multi-lane roadways. It is also an affordable option.	Useful in areas where pedestrian visibility is low and in areas with aggressive drivers, as advance limit lines will help prevent drivers from encroaching on the crosswalk. Addresses the multiple-threat collision on multi-lane roads.
Geometric Treatments			
Pedestrian Overpass/ Underpass	This measure consists of a pedestrian-only overpass or underpass over a roadway. It provides complete separation of pedestrians from motor vehicle traffic, normally where no other pedestrian facility is available, and connects off-road trails and paths across major barriers.	Pedestrian overpasses and underpasses allow for the uninterrupted flow of pedestrian movement separate from the vehicle traffic.	Grade separation via this measure is most feasible and appropriate in extreme cases where pedestrians must cross roadways such as freeways and high-speed, high-volume arterials. This measure should be considered a last resort, as it is expensive and visually intrusive.
Road Diet (aka Lane Reduction)	The number of lanes of travel is reduced by widening sidewalks, adding bicycle and parking lanes, and converting parallel parking to angled or perpendicular parking.	This is a good traffic calming and pedestrian safety tool, particularly in areas that would benefit from curb extensions but have infrastructure in the way. This measure also improves pedestrian conditions on multi-lane roadways.	Roadways with surplus roadway capacity (typically multi-lane roadways with less than 15,000 to 17,000 ADT) and high bicycle volumes, and roadways that would benefit from traffic calming measures.

Pedestrian Improvement Measures			
Measure	**Description**	**Benefits**	**Application**
Median Refuge Island	Raised islands are placed in the center of a roadway, separating opposing lanes of traffic with cutouts for accessibility along the pedestrian path.	This measure allows pedestrians to focus on each direction of traffic separately, and the refuge provides pedestrians with a better view of oncoming traffic as well as allowing drivers to see pedestrians more easily. It can also split up a multi-lane road and act as a supplement to additional pedestrian tools.	Recommended for multi-lane roads wide enough to accommodate an ADA-accessible median.
Staggered Median Refuge Island	This measure is similar to traditional median refuge islands; the only difference is that the crosswalks in the roadway are staggered such that a pedestrian crosses half the street and then must walk towards traffic to reach the second half of the crosswalk. This measure must be designed for accessibility by including rails and truncated domes to direct sight-impaired pedestrians along the path of travel.	Benefits of this tool include an increase in the concentration of pedestrians at a crossing and the provision of better traffic views for pedestrians. Additionally, motorists are better able to see pedestrians as they walk through the staggered refuge.	Best used on multi-lane roads with obstructed pedestrian visibility or with off-set intersections.
Curb Extension	Also known as a pedestrian bulb-out, this traffic-calming measure is meant to slow traffic and increase driver awareness. It consists of an extension of the curb into the street, making the pedestrian space (sidewalk) wider.	Curb extensions narrow the distance that a pedestrian has to cross and increases the sidewalk space on the corners. They also improve emergency vehicle access and make it difficult for drivers to turn illegally.	Due to the high cost of installation, this tool would only be suitable on streets with high pedestrian activity, on-street parking, and infrequent (or no) curb-edge transit service. It is often used in combination with crosswalks or other markings.
Reduced Curb Radii	The radius of a curb can be reduced to require motorists to make a tighter turn.	Shorter radii narrow the distance that pedestrians have to cross; they also reduce traffic speeds and increase driver awareness (like curb extensions), but are less difficult and expensive to implement.	This measure would be beneficial on streets with high pedestrian activity, on-street parking, and no curb-edge transit service. It is more suitable for wider roadways and roadways with low volumes of heavy truck traffic.

Pedestrian Improvement Measures			
Measure	**Description**	**Benefits**	**Application**
Curb Ramps	Curb ramps are sloped ramps that are constructed at the edge of a curb (normally at intersections) as a transition between the sidewalk and a crosswalk.	Curb ramps provide easy access between the sidewalk and roadway for people using wheelchairs, strollers, walkers, crutches, handcarts, bicycles, and also for pedestrians with mobility impairments who have trouble stepping up and down high curbs.	Curb ramps must be installed at all intersections and mid-block locations where pedestrian crossings exist, as mandated by federal legislation (1973 Rehabilitation Act and 1990 Americans with Disabilities Act). Where feasible, separate curb ramps for each crosswalk at an intersection should be provided rather than having a single ramp at a corner for both crosswalks.
Raised Crosswalk	A crosswalk whose surface is elevated above the travel lanes.	Attracts drivers' attention; encourages lower travel speeds by providing visual and tactile feedback when approaching the crosswalk.	Appropriate for multi-lane roadways, roadways with lower speed limits that are not emergency routes, and roadways with high levels of pedestrian activity, such as near schools, shopping malls, etc.
Improved Right-Turn Slip-Lane Design	Right-turn slip lanes (aka channelized right-turn lanes) are separated from the rest of the travel lanes by a pork chop-shaped striped area. This measure separates right-turning traffic and streamlines right-turning movements. Improved right-turn slip lanes would provide pedestrian crossing islands within the intersection and be designed to optimize the right-turning motorist’s view of the pedestrian and of vehicles to his or her left.	This measure reduces the pedestrian's crossing distance and turning vehicle speeds.	Appropriate for intersections with high volumes of right-turning vehicles.

Pedestrian Improvement Measures			
Measure	**Description**	**Benefits**	**Application**
Chicanes	A chicane is a sequence of tight serpentine curves (usually an S-shape curve) in a roadway, used on city streets to slow cars.	This is a traffic-calming measure that can improve the pedestrian environment and pedestrian safety.	Chicanes can be created on streets with higher volumes, given that the number of through lanes is maintained; they can also be created on higher-volume residential streets to slow traffic. Chicanes may be constructed by alternating parallel or angled parking in combination with curb extensions.
Pedestrian Access and Amenities			
Marked Crosswalk	Marked crosswalks should be installed to provide designated pedestrian crossings at major pedestrian generators, crossings with significant pedestrian volumes (at least 15 per hour), crossings with high vehicle-pedestrian collisions, and other areas based on engineering judgment.	Marked crosswalks provide a designated crossing, which may improve walkability and reduce jaywalking.	Marked crosswalks alone should not be installed on multi-lane roads with more than about 10,000 vehicles/day. Enhanced crosswalk treatments (as presented in this table) should supplement the marked crosswalk.
Textured Pavers	Textured pavers come in a variety of materials (for example, concrete, brick, and stone) and can be constructed to create a textured pedestrian surface such as a crosswalk or sidewalk. Crosswalks are constructed with the pavers, or can be made of stamped concrete or asphalt.	Highly visible to motorists, this measure provides a visual and tactile cue to motorists and delineates a separate space for pedestrians, as it provides a different texture to the street for pedestrians and motorists. It also aesthetically enhances the streetscape.	Appropriate for areas with high volumes of pedestrian traffic and roadways with low visibility and/or narrow travel ways, as in the downtown area of towns and small cities.

Pedestrian Improvement Measures			
Measure	**Description**	**Benefits**	**Application**
Anti-Skid Surfacing	Surface treatment is applied to streets to improve skid resistance during wet weather. This is a supplementary tool that can be used to reduce skidding in wet conditions.	Improves driver and pedestrian safety.	Appropriate for multi-lane roadways and roadways with higher posted speed limit and/or high vehicle volumes or collision rates.
Accessibility Upgrades	Treatments such as audible pedestrian signals, accessible push buttons, and truncated domes should be installed at crossings to accommodate disabled pedestrians.	Improves accessibility of pedestrian facilities for all users.	Accessibility upgrades should be provided for all pedestrian facilities following a citywide ADA Transition Plan.
Pedestrian Countdown Signal	Displays a “countdown” of the number of seconds remaining for the pedestrian crossing interval. In some jurisdictions the countdown includes the walk phase. In other jurisdictions, the countdown is only displayed during the flashing don’t walk phase.	Increases pedestrian awareness and allows them the flexibility to know when to speed up if the pedestrian phase is about to expire.	The forthcoming 2009 MUTCD is expected to require all pedestrian signals to incorporated countdown signals within ten years. The signals should be prioritized for areas with pedestrian activity, roadways with high volumes of vehicular traffic, multi-lane roadways, and areas with elderly or disabled persons (who may walk slower than others may).
Transit			
High-Visibility Bus Stop Locations	This measure should include siting bus stops on the far side of intersections, with paved connections to sidewalks where landscape buffers exist.	Provides safe, convenient, and inviting access for transit users; can improve roadway efficiency and driver sight distance.	Appropriate for all bus stops subject to sight distance and right-of-way constraints.
Transit Bulb	Transit bulbs or bus bulbs, also known as nubs, curb extensions, or bus bulges are a section of sidewalk that extends from the curb of a parking lane to the edge of the through lane.	Creates additional space at a bus stop for shelters, benches, and other passenger amenities.	Appropriate at sites with high patron volumes, crowded city sidewalks, and curbside parking.

APPENDIX B: GLOSSARY OF BICYCLING IMPROVEMENT MEASURES

Bicycling Improvement Measures			
Measure	**Description**	**Benefits**	**Application**
LINKS /ROADWAY SEGMENTS			
A. Road Design and Operations to Slow Traffic			
Traffic Calming	There are a variety of measures too numerous to list here. See ITE Institute of Transportation Engineers, "Traffic Calming: State of the Practice".	Reduces motor vehicle speeds, which improves safety for all modes and increases bicyclist's comfort.	Urban and suburban settings; suggested for urban major streets with prevailing speeds of 35 mph and higher and for suburban major streets with prevailing speeds 45 mph or higher; and for all local streets with speeds of 30+ mph.
Bicycle Boulevard	A minor street on which traffic control devices are designed and placed to encourage cycling; these include: unwarranted stop signs along bike route are removed; crossing assistance at major arterials is provided (see examples in Nodes-Section E below).	Allows cyclists to maintain their travel speeds, significantly reducing their travel time; provides cyclists with a low volume, low speed street where motorists are aware that it is a bicycle-priority street.	On minor streets with less than 3000 vehicles per day especially useful when Bike Blvd is parallel to and within ¼ mile of a major arterial with many desirable destinations.
Signal Coordination at 15 -25 mph	The signal timing along a corridor is set so that traffic which receives a green light at the first intersection will subsequently receive a green light at all downstream intersections if they travel at the design speed; aka a "green wave."	Encourages motorists to travel at slower speeds, provides a more comfortable experience for cyclists and increases overall traffic safety; also allows cyclists to hit the green lights, so that they can maintain their travel speeds, significantly reducing their travel time.	Urban settings, typically downtown and other areas with relatively short blocks and with traffic signals at every intersection.
Woonerf/Shared Space	A shared space concept where the entire public right of way is available for all modes, often with no sidewalks, and with no lane striping, and little if any signage.	Access for motor vehicles is maintained, unlike a pedestrian zone, but motor vehicle speeds are constrained to 5 mph by design and the presence of other modes. Safety for all modes is improved.	Low volume residential streets where families can gather and children are encouraged to play; also commercial areas with high pedestrian volumes, bicyclists and transit.

B. Road Design to Provide Bicycle Infrastructure			
Bike Lanes	A painted lane for the exclusive use of bicyclists; it is one-way and is 5 feet minimum in width. They can be retrofitted onto an existing street by either a) narrowing existing wide travel lanes; b) removing a parking lane; c) removing a travel lane, or d) widening the roadway. A common method to retrofit bike lanes is described below.	Provides cyclists with their own travel lane so that they can safely pass and be passed by motor vehicles.	Roadways with over 4000 vehicles per day (if less than 4000 vehicles per day see Bicycle Boulevards above).
Road Diet (aka Lane Reduction)	One to two travel lanes are replaced with a bike lane in each direction, and in most cases by also adding left-turn lanes at intersections or a center two-way left-turn lane; variations include widening sidewalks, and replacing parallel parking with angled or perpendicular parking.	Improves traffic safety for all modes by: a) eliminating the double-threat to pedestrians posed by the two or more travel lanes in each direction; b) providing bike lanes for cyclists; c) providing a left-turn pocket for motorists, reducing rear-end collisions and improving visibility to oncoming traffic.	Classic application is a four-lane undivided roadway with less than 15,000 to 17,000 ADT though conversions of four-lane streets may work up to 23,000 ADT. Also applies to three-lane roadways and to 5 or 6-lane undivided roadways
Buffer adjacent to bike lanes	A three to five-foot buffer area is provided on one or both sides of the bike lane.	Right-side buffer (between bike lane and on-street parking): Removes cyclists from the door zone; Left-side (between bike lane and adjacent travel lane): provides greater separation from passing motor vehicle traffic.	This measure is particularly beneficial in the following conditions: Right-side: on streets with parallel on-street parking particularly in cities with a collision history of dooring; Left-side: on streets with traffic with prevailing speeds of 40 mph and higher.
Cycle Tracks	A bikeway within the roadway right of way that is separated from both traffic lanes and the sidewalks by either a parking lane, street furniture, curbs or other physical means.	Reduces sidewalk riding, provides greater separation between motorists and cyclists.	Urban settings with parallel sidewalks and heavy traffic.
C Other Traffic Control Devices			
Except Bicycles placard	A Regulatory sign placard for use with other regulatory signs.	Increases or maintains the access and circulation capabilities of bicyclists.	Used at locations where the restriction in question does not apply to bicyclists, such as No Left Turn or Do Not Enter.

Sharrows	A pavement legend that indicates the location within the travel lane where bicyclists are expected to occupy.	The sharrow encourages cyclists to ride outside of the door zone and studies have shown that sharrows reduce the incidence of cyclists riding on the sidewalk and wrong-way riding.	Two or more lane city streets where the right-most lane is too narrow for a motor vehicle to safely pass a cyclist within the travel lane.
Bike Lanes May Use Full Lane sign (MUTCD R4-11)	Regulatory Sign	Informs motorists and cyclists that cyclists may be travelling in the center of a narrow lane.	Two or more lane city streets where the right-most lane is too narrow for a motor vehicle to safely pass a cyclist within the travel lane.
Share the Road sign (MUTCD W-11/ W16-1p)	Warning sign and placard	Informs motorists to expect cyclists on the roadway.	Two-lane roads particularly in rural areas where shoulders are less than four-feet.
Bike Directional Signs (MUTCD D1 series or similar)	Informational signs indicating place names and arrows, with distances as a recommended option (D1-2C)	Informs bicyclists of the most common destination served by the bike route in question.	Particularly useful to direct cyclists to a facility such as a bike bridge or to use a street to access a major destination that might not otherwise be readily apparent.
D. New infrastructure to improve bicycle connectivity			
Bike Path	A paved pathway for the exclusive use of non-motorized traffic within its own right of way;	Provides additional connectivity and route options that otherwise would not be available to bicyclists.	Wherever a continuous right of way exists, typically found along active or abandoned railroad ROW, shorelines, creeks, and river levees.
Pathway connections	Short pathway segments for non-motorized traffic, for example, that join the ends of two cul-de-sacs or provide other connectivity not provided by road network.	Provides short-cuts for bicyclists that reduce their travel distance and travel time.	Varies by community; suggested at the end of every newly constructed cul-de-sac.
Bicycle Overpass/ Underpass	A bicycle overpass or underpass is a bridge or tunnel built for the exclusive use of non-motorized traffic and is typically built where at-grade crossings cannot be provided such as to cross freeways, rivers, creeks and railroad tracks. They can also be built to cross major arterials where, for example, a bike path must cross a major roadway.	A bike bridge / tunnel complement a local roadway system that is discontinuous due to man-made or natural barriers. They reduce the distance traveled by cyclists, and provide a safer conflict-free crossing, particularly if it is an alternative to a freeway interchange.	Grade separation via this measure is most feasible and appropriate when it would provide direct access to major bicyclist destinations such as a school or college, employment site, major transit station or would reduce the travel distance by one mile or more.

NODES / INTERSECTIONS			
Measure	**Description**	**Benefits**	**Application**
E. Intersection Design For Motor Vehicles			
Reduced Curb Radii	The radius of a curb is reduced to require motorists to make the turn at slower speeds and to make a tighter turn.	Shorter curb radii reduce the speed of turning traffic thereby enabling a more comfortable weave between through cyclists and right-turning motorists.	This measure is suitable for downtown settings, at all cross streets with minor streets, all residential streets and all roadways that are not designated truck routes.
Remove/Control Free Right-Turn Lanes	Where a separate right-turn lane continues as its own lane after the turn, it may be redesigned to eliminate the free turn. A short-term solution is to control the turning movement with a stop sign or signal control and to redesign the island as discussed below.	Improves bicyclist safety since this design forces through cyclists on the cross street to end up in between two lanes of through motor vehicle traffic.	All locations where there are free right-turn lanes except those leading onto freeway on-ramps.
Remove/Redesign Right-Turn Slip-Lane Design	Right-turn slip lanes (aka channelized right-turn lanes) are separated from the rest of the travel lanes by a pork chop-shaped raised island that is typically designed to facilitate fast right turns, and right-turning vehicles are often not subject to the traffic signal or stop sign.	Improves bicyclist safety by slowing right-turning motorists and facilitates the weave between through bicyclists and right-turning motorists.	All locations with a channelized right-turn.
Remove Optional Right-Turn Lane in Combination with a Right-Turn Only Lane	At locations where there is an optional right-turn lane in combination with a right-turn only lane, convert the optional right-turn lane to a through-only lane.	Improves bicyclist safety since cyclists have no way of knowing how to correctly position themselves in the optional (through /right turn) lane.	All locations where there is an optional right-turn lane in combination with a right-turn only lane per HDM 403.6(1) (except on freeways).
Redesign Ramp Termini	Redesign high speed free flow freeway ramps to intersection local streets as standard intersections with signal control.	Improves bicyclist and pedestrian safety on intersections of local streets with freeway ramps.	All freeway interchanges with high speed ramps

F. Intersection Design Treatments - Bicycle -Specific			
Bicycle Signal Detection and Pavement Marking	Provide signal detectors that also detect bicyclists in the rightmost through lane and in left-turn lanes with left-turn phasing. Provide pavement marking to indicate to cyclists where to position themselves in order to activate the detector.	Enables cyclists to be detected when motor vehicles are not present to trigger the needed signal phase. Improves bicyclists' safety.	Per CA MUTCD 4D.105 and CVC 21450.5, all new and modified traffic detection installations must detect bicyclists; All other traffic-actuated signals may be retrofitted to detect bicyclists as soon as feasible.
Bicycle Signal Timing	Provides signal timing to account for the speed of cyclists to cross an intersection.	Improves bicyclists' safety by reducing the probability of a bicyclist being in an intersection when the phase terminates and being hit by traffic that receives the next green phase.	Signal timing that accounts for cyclists is particularly important for cyclists on a minor street approach to a major arterial which crosses a greater distance due to the width of the arterial, hence requiring a longer time interval.
Bicycle Signal Heads	A traffic signal indication in the shape of a bicycle, with full red, yellow green capability.	Improves bicyclist safety by providing a bicycle -only phase, where appropriate, given the geometry and phasing of the particular intersection.	Where intersection geometry is such that a bicycle-only phase is provided and/or bicycle signal heads would improve safety at the intersection. See also CA MUTCD for warrants for bicycle signal heads.
Widen Bike Lane at Intersection Approach	Within the last 200 feet of an intersection, widen the bike lane and narrow the travel; for example from 5 foot bike lane and 12 feet travel lane would become a 7 foot bike lane and 10 foot travel lane.	Improves cyclist safety by encouraging right-turning motorists to enter the bike lane to turn right, (as required by the CVC), which reduces the chance of a right-turn hook collision in which a through cyclist remains to the right of a right-turning motorist.	On roads with bike lanes approaching an intersection without a right-turn only lane and there is noncompliance with right-turning vehicles merging into the bike lane as required by the CVC and UVC.
Bike Lane inside Right-Turn Only Lane ("Combined Bicycle/Right-Turn Lane")	Provide a bike lane line inside and on the left side of a right-turn only lane.	Encourages cyclists to ride on the left side of the right-turn only lane thus reducing the chance of a right hook collision, where a cyclist remains to the right of a right-turning motorist.	On roads with bike lanes approaching an intersection with a right-turn only lane and there is not enough roadway width to provide a bike lane to the left of the right-turn lane.

Bike Boxes	Area between an Advance Stop Line and a marked crosswalk designated as the queue space for cyclists to wait for a green light ahead of queued motor vehicle traffic; sometimes painted green.	Primary benefits are to reduce conflicts between bicyclists and right-turning traffic at the onset of the green signal phase, and to reduce vehicle and bicyclist encroachment in a crosswalk during a red signal phase.	Locations where there are at least three cyclists at the beginning of the green phase and moderate to high pedestrian volumes.
Marked Crosswalk with Distinct Marked Area for Bicyclists separate from Pedestrians	A marked crosswalk that has two distinct areas, one for pedestrians and one for bicyclists.	Reduces conflicts between bicyclists and pedestrians by indicating the part of the crosswalk intended for the two different modes.	At a typical intersection, cyclists would not be riding within the crosswalk, so this measure is intended for those few locations where the intersection design is such that bicyclists are tracked into a crosswalk such as at a midblock bike path crossing or possibly a cycle track.
Pedestrian Countdown Signal	Displays a “countdown” of the number of seconds remaining for the pedestrian crossing interval. In some jurisdictions the countdown includes the walk phase. In other jurisdictions, the countdown is only displayed during the flashing don’t walk phase.	While designed for pedestrians, this measure also assists bicyclists in knowing the time remaining to cross the intersection.	The 2012 MUTCD requires all pedestrian signals to incorporated countdown signals within ten years
Measure	**Description**	**Benefits**	**Application**
G. Geometric Countermeasures to Assist crossing a Major Street			
Median Refuge Island	A raised island placed in the center of a roadway, separating opposing lanes of traffic, with ramps for cyclists and ADA accessibility	This measure allows bicyclists to cross one direction of traffic at a time; it allows drivers to see bicyclists crossing from the center more easily.	Suggested for multilane roads at uncontrolled crossings where an 8-foot (min.) wide by 15-foot (min.) long median can be provided.
Staggered Refuge Pedestrian Island	This measure is similar to traditional median refuge islands; the only difference is that the crosswalk is staggered such that a pedestrian crosses one direction of traffic street and then must turn to their right facing oncoming to reach the second part of the crosswalk. This measure must be designed for accessibility by including rails and truncated domes to direct sight-impaired pedestrians along the path of travel.	Benefits of this measure include forcing the bicyclists and pedestrians to face the oncoming motorists, increasing their awareness of the impending conflict. Additionally, can improve motorists’ visibility to those persons in the crosswalk.	Best used on multilane roads with obstructed pedestrian visibility or with off-set intersections

Raised Crosswalk/Speed Table	A crosswalk whose surface is elevated above the travel lanes at the same level as the approaching sidewalk. For bicyclists, a typical location would be at a bike path crossing, where the bike path elevation would remain constant while roadway cross traffic would experience a speed-hump type effect.	Attracts drivers' attention to the fact there will be non-motorized users crossing the roadway, and slows traffic by providing a speed-hump effect for motorists approaching the crosswalk.	Appropriate for multi-lane roadways, roadways with lower speed limits that are not emergency routes, and roadways with high levels of pedestrian activity, such as near schools, shopping malls, etc.
Measure	**Description**	**Benefits**	**Application**
H. Traffic Control Countermeasures to Assist Crossing a Major Street			
Traffic Signal or All-Way Stop Sign	Conventional traffic control devices with warrants for use based on the Manual on Uniform Control Devices (MUTCD)	Provides the gap needed in traffic flow so that cyclists can cross the street, reducing bicycle-vehicle conflicts and risk-taking by cyclists	Must meet warrants based on traffic/ pedestrian / bicycle volumes, collision history, and/ or other factors.
Modern Roundabout	A traffic circle combined with splitter island on all approaches and entering traffic must YIELD to traffic within the roundabout; typically designed for traffic speed within the roundabout of between 15 and 23 mph.	Slows traffic on cross street so that cyclists can more easily cross.	Roundabouts are a better alternative than an All-Way Stop signs when the side street volume is approximately 30 % of the total intersection traffic volume and total peak hour volume is less than 2300 vehicles per day.
Hawk Beacon Signal	HAWK (High Intensity Activated Crosswalks) are pedestrian-bicyclist actuated signals that are a combination of a beacon flasher and a traffic control signal. When actuated, HAWK displays a yellow (warning) indication followed by a solid red light. During the cross street phase, the driver sees a flashing red “wig-wag” pattern until the clearance interval has ended and the signal goes dark.	Provides the need gaps in traffic so bicyclists can safely cross the street, can be timed separately for bicycles and pedestrians. Reduces pedestrian-vehicle conflicts and slows traffic speeds	Useful in areas where it is difficult for bicyclists /pedestrians to find gaps in automobile traffic to cross safely, but where normal signal warrants are not satisfied. Appropriate for multilane roadways.
Rectangular Rapid Flashing Beacon (RRFB/Stutter Flash)	A warning sign that also contains rapid flashing LED lamps. The beacon may be push-button activated or activated with pedestrian detection.	Initial studies suggest the stutter flash is very effective as measured by increased driver yielding behavior. Solar panels reduce energy costs associated with the device.	Locations not controlled by any measures listed above. Appropriate for multi-lane roadways.

In-Roadway Warning Lights	Both sides of a crosswalk are lined with pavement markers, often containing an amber LED strobe light. The lights may be push-button activated or activated with pedestrian detection.	This measure provides a dynamic visual cue of the uncontrolled crosswalk, and is especially effective at night and in bad weather.	Locations not controlled by any measures listed above. Best in locations with low bicycle ridership on the cross street, as the raised markers may present difficulty to bicyclists. May not be appropriate in areas with heavy winter weather due to high maintenance costs. May not be appropriate for locations with bright sunlight.
Bicycle Crossing Sign (MUTCD W11-1) or Trail Crossing sign (MUTCD W11-15/W11-15p)	Warning Sign and placard.	Alerts motorists to a location where bicyclists or bicyclists and pedestrians will be crossing the roadway at an uncontrolled location.	Typical application is at bike path crossing of a roadway. (At a typical pedestrian crosswalk at an intersection, use the Pedestrian warning sign W11-2)
In-Street Pedestrian Crossing Signs (MUTCD R1-6)	This measure involves posting this regulatory sign on road centerlines that read, “YIELD for Pedestrians in crosswalk”. (Depending on state law, the word STOP may replace the word YIELD).	This measure improves the visibility of the crossing to motorists and has a positive impact on pedestrian safety at crosswalks.	Mid-block crosswalks, unsignalized intersections, low-speed areas, and two-lane roadways.
Advanced Yield Lines	Standard white stop or yield limit lines are placed 20-50 feet in advance of marked, uncontrolled crosswalks.	This measure increases the pedestrian’s visibility to motorists, reduces the number of vehicles encroaching on the crosswalk, and improves general pedestrian conditions on multi-lane roadways. It is also an affordable option.	Useful in areas where pedestrian visibility is low and in areas with aggressive drivers, as advance limit lines will help prevent drivers from encroaching on the crosswalk. Addresses the multiple-threat collision on multi-lane roads.
Transit			
Bike Racks on Buses	A rack on the front of the bus that typically holds two or three bicycles.	Increases the trip length distance that a person can make.	Appropriate for all buses; most urban transit agencies have already implemented this measure.
Bikes allowed inside buses when bike rack is full	A policy adopted by a transit agency that allows passengers to bring bicycles inside the bus when the bike rack is full and there is room inside.	Prevents cyclists from needless being left behind to wait for the next bus if the bike rack is full yet there is room inside the bus.	Appropriate for all buses; most urban transit agencies have already implemented this measure.

Folding bikes allowed inside buses	A policy adopted by a transit agency that treats a folding bicycle as luggage, thereby allowing it inside the bus at all times.	Removes cyclists' uncertainty as to whether they will be able to fit their bike either on the bike rack or inside the bus; thus they can reliably plan on being able to catch their intended bus.	Appropriate for all buses; most urban transit agencies have already implemented this measure.

APPENDIX C: RESOURCE LIST AND REFERENCES

Resource List and References	
➔ Pedestrian and Bicycle Information Center ("PBIC") http://www.bicyclinginfo.org	Along with walkinginfo.org, a resource site maintained by UNC Highway Safety Research Center (UNC-HSRC)
➔ Pedestrian and Bicycle Crash Analysis Tool ("PBCAT") http://www.walkinginfo.org/facts/pbcat/index.cfm	Crash typing software product intended to assist planners and engineers with improving walking and bicycling safety through the development and analysis of a database containing details of crashes between motor vehicles and pedestrians or bicyclists
➔ FHWA On-Demand Bicycle Safety Training Courses http://www.bicyclinginfo.org/training/ondemand-training.cfm	FHWA University Course on Bicycle and Pedestrian Transportation / National Highway Institute Bicycle Facility Design Course / Safe Routes to School National Course APBP National Complete Streets Workshops
➔ FHWA University Course on Bicycle and Pedestrian Transportation, Report No. FHWA-HRT-05-085 http://www.tfhrc.gov/safety/pedbike/pubs/05085	A detailed 24-lesson course in planning and design for non-motorized transportation.
➔ FHWA Official Rulings website http://mutcd.fhwa.dot.gov/orsearch.asp	List of FHWA communications regarding experiments, and interpretation of documents (Requests To Experiment / RTEs, response letters, progress reports, final reports, changes).
➔ FHWA Interim Approvals webpage http://mutcd.fhwa.dot.gov/res-interim_approvals.htm	List of all Interim Approvals granted by FHWA. Interim Approvals enable states and local agencies to request approval to use a new device without experimentation before the device is incorporated into a future edition of the MUTCD.
➔ FHWA "Bicycle Facilities and the Manual on Uniform Traffic Control Devices" webpage http://www.fhwa.dot.gov/environment/bicycle_pedestrian/guidance/design_guidance/mutcd_bike.cfm	Status in the 2009 US MUTCD of various bicycle-related signs, markings, signals, and other treatments (e.g., can be implemented, Interim Approval, currently experimental).
➔ FHWA DRAFT Accessibility Guidance for Bicycle and Pedestrian Facilities, Recreational Trails, and Transportation Enhancement Activities (2008) http://www.fhwa.dot.gov/environment/recreational_trails/guidance/accessibility_guidance/guidance_accessibility.cfm	Summary of current accessibility standards, pending standards, guidelines under development, program accessibility, accessibility design criteria for sidewalks, street crossings and shared use paths and trails
➔ FHWA Bollards, Gates and other Barriers (webpage) http://www.fhwa.dot.gov/environment/recreational_trails/guidance/accessibility_guidance/bollards_access.cfm	Current guidance on the hazards of bollards, gates, fences and other barriers to restrict unauthorized use of paths. Alternatives to bollards and gates.
➔ California Traffic Control Devices Committee (CTCDC) http://www.dot.ca.gov/hq/traffops/signtech/newtech/	Committee agendas, minutes, annual reports, experiment status and reports, experimentation guidelines and requests, implementation of FHWA-issued Interim Approvals.
➔ *Caltrans Complete Streets webpage http://www.dot.ca.gov/hq/tpp/offices/ocp/complete_streets.html*	*Complete Intersections guide and other resources*
➔ *Road Safety Audits: Case Studies (FHWA-SA-06-17) http://safety.fhwa.dot.gov/rsa/rsa_cstudies.htm*	
➔ *Bicycle Road Safety Audit Guidelines and Prompt Lists FHWA-SA-12-018 http://safety.fhwa.dot.gov/ped_bike/tools_solve/fhwasa12018/*	
➔ *National Center for Safe Routes to School http://www.saferoutesinfo.org/*	*Resources for Infrastructure (engineering, safety, planning, design) and non-infrastructure (education, promotion, outreach) in support of Active Transportation in school commutes*

Adapted from FHWA Pedestrian Road Safety Audit Guidelines and Prompt Lists

Resources For Experimentation And Interim Approvals	
➔ FHWA "Bicycle Facilities and the Manual on Uniform Traffic Control Devices" webpage http://www.fhwa.dot.gov/environment/bicycle_pedestrian/guidance/design_guidance/mutcd_bike.cfm	Status in the 2009 US MUTCD of various bicycle-related signs, markings, signals, and other treatments (e.g., can be implemented, Interim Approval, currently experimental). Start here to determine whether a device requires experimentation.
➔ FHWA Interim Approvals webpage http://mutcd.fhwa.dot.gov/res-interim_approvals.htm	List of all Interim Approvals granted by FHWA. Interim Approvals enable states and local agencies to request approval to use a new device without experimentation before the device is adopted in a future edition of the MUTCD.
➔ FHWA Official Rulings website http://mutcd.fhwa.dot.gov/orsearch.asp	List of FHWA communications regarding experiments, and interpretation of documents (Requests To Experiment / RTEs, response letters, progress reports, final reports, changes).
➔ California Traffic Control Devices Committee (CTCDC) http://www.dot.ca.gov/hq/traffops/signtech/newtech/	Committee agendas, minutes, annual reports, experiment status and reports, experimentation guidelines and requests, implementation of FHWA-issued Interim Approvals.
➔ FHWA (U.S.) Manual on Uniform Traffic Control Devices (MUTCD) (2009), Section 1A.10 http://mutcd.fhwa.dot.gov/ *NOTE: All US MUTCD content appears in-line in the California MUTCD, with California differences shown in blue, and California tables and figures identified with (CA).*	Section 1A10 Interpretations, Experimentations, Changes and Interim Approvals covers the design, application and placement of traffic control devices other than those adopted in the MUTCD. Figure 1A.1 Process for Requesting and Conducting Experimentation for New Traffic Control Devices is a flowchart of the federal (FHWA) process. Figure 1A.2 Process for Incorporating New Traffic Control Devices into the MUTCD is a flowchart of the process after successful experimentation, a research study, or a request from a jurisdiction or interested party
➔ California Manual on Uniform Traffic Control Devices (MUTCD) (2012), Section 1A.10 http://www.dot.ca.gov/hq/traffops/signtech/mutcdsupp/ca_mutcd2012.htm NOTE: All US MUTCD content appears in-line in the California MUTCD	Figure 1A.1 (CA) Process for Requesting and Conducting Experimentation for New Traffic Control Devices in California is a flowchart of the California (CTCDC) process. Figure 1A.101 (CA) Process for the Use of Traffic Control Devices Approved as Interim Approval (IA) by FHWA is a flowchart of additional steps in California before a device granted Interim Approval by FHWA may be used.

REFERENCES

Appleyard, Bruce. 2009. *Pedestrian and Bicycle Planning*. An ICMA Green Book Local Planning: Contemporary Principles and Practice. Editors: Hack et al. ICMA

California Local Government Commission, Center for Livable Communities. *Economic Benefits of Walkable Communities*. http://www.lgc.org/freepub/PDF/Land_Use/focus/walk_to_money.pdf.

Dill, Jennifer. *Measuring Connectivity for Bicycling and Walking.* Presented at Pro Walk/ Pro Bike, September 9, 2004. Accessed online at http://web.pdx.edu/~jdill/PWPB_Connectivity_slides.pdf.

Pedestrian and Bicycle Information Center. *El Cajon's Road Diet Case Study.* http://www.walkinginfo.org/library/details.cfm?id=3967.

Zegeer, Charles V., et al. *Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations*. Report HRT-04-100. http://www.thrc.gov/safety/pubs/04100/index.htm

CROW, *Design Manual for Bicycle Traffic*, The Netherlands http://www.crow.nl/nl/Publicaties/publicatiedetail?code=REC25

Transport for London, *London Cycling Design Standards*, UK http://www.tfl.gov.uk/businessandpartners/publications/2766.aspx

Thompson, Laura and Julie Bondurant, *Trail Planning in California*, Solano Press, 2009

Fundamentals of Traffic Engineering, 16th Edition, Chapter 21: Bicycle Facilities; UC Berkeley Institute of Transportation Studies 2007.

DeRobertis, Michelle and Rhonda Rae, Buses and Bicycles: Design Options For Sharing The Road, *ITE Journal*, May 2001.

Thomas, Beth and Michelle DeRobertis, Cycle Track Literature Review, *Accident Analysis and Prevention*, Volume 52, pp. 219-227, March 28, 2013.

Hillsman, Edward L. et al, *A Summary of Design, Policies and Operational Characteristics for Shared Bicycle/Bus Lanes*, Project No. BDK85 977-32, University of South Florida, July 2012

Mekuria, Maaza C., Peter G. Furth, and Hilary Nixon, *Low-Stress Bicycling And Network Connectivity*, Mineta Transportation Institute, May 2012

Thompson S.R. et al, *Bicycle-Specific Traffic Signals: Results from a State-of-the-Practice Review*, Transportation Research Board, January 2013, Paper # 13-0536

APPENDIX D: STREET CONNECTIVITY

Importance of Street Connectivity

Providing direct paths for bicyclists and pedestrians via well-connected street networks is important for encouraging bicycling and walking by helping people overcome real and perceived senses of distance.

Street connectivity is also associated with public health benefits. The SMARTRAQ Project analysis in Atlanta, Georgia, found that doubling the current regional average intersection density, from 8.3 to 16.6 intersections per square kilometer was associated with a reduction in average per capita vehicle mileage of about 1.6 percent. Furthermore, the Frank et al. (2006) study of King County, Washington, found that per-household VMT declines with increased street connectivity, all else held constant.

Policies for Street Connectivity

A network of safe, direct, and comfortable routes and facilities: A 2004 PAS report recommends that pedestrian (and bicycle) path connections be every 300 to 500 feet; for motor vehicles, they recommend 500 to 1,000 feet.[2] [3] For new development, such standards can be implemented through ordinances, like those of the regional government of Portland Oregon, Metro, which requires street connectivity in its Regional Transportation Plan and in the development codes and design standards of its constituent local governments.[4]

Measuring Connectivity

The following discussion of measuring street connectivity is provided as a resource and not officially a part of regular BSA processes. However, individuals are certainly encouraged to make such calculations.

Jennifer Dill (2004) presents the following measures of street connectivity:

- Intersection density
- Street density

[2] Susan Handy, Robert G. Paterson, and Kent Butler, 2004, *Planning for Street Connectivity: Getting from Here to There,* PAS Report #515 (Chicago: APA Planners Press).

[3] For more information on this topic, see American Association of State Highway and Transportation Officials (AASHTO), *AASHTO Guide for the Design of Pedestrian Facilities* (Washington, D.C., AASHTO, 2004); *AASHTO Guide for the Development of Bicycle Facilities* (Washington, D.C., AASHTO, 1999; updated 2009); Institute of Traffic Engineers (ITE), Traffic Calming Guidelines and ITE *Context-Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities*? (Washington, D.C.: ITE, 2006), http://www.ite.org/bookstore/RP036.pdf (accessed September 3, 2008).

[4] The regional government of Portland Oregon, Metro, requires street connectivity in its Regional Transportation Plan and in the development codes and design standards of its constituent local governments as follows: local and arterial streets be spaced no more than 530 feet apart (except where barriers exist), bicycle and pedestrian connections must be made (via pathways or on road right of ways) every 330 feet, Cul de sacs (or dead-end streets) are discouraged and can be no longer than 200 feet, and have no more than 25 dwelling units.

- Average block length
- Link/node ratio
- Connected node ratio = intersections/ (intersections + cul-de-sacs)
- Alpha index = number of actual circuits/ maximum number of circuits

Where a circuit is a finite, closed path starting and ending at a single node

- Gamma index = number of links in the network/ maximum possible number of links between nodes
- Effective walking area = number of parcels within a one-quarter mile walking distance of a point/ total number of parcels within a one-quarter mile radius of that point
- Route directness = route distance/ straight-line distance for two selected points

Dill suggests that route directness (RD) is perhaps the best connectivity measure to reflect minimizing trip distances, but may be difficult to use in research and policy. However, it may be applied in practice by randomly selecting origin-destination pairs and calculating a sample for the subject area.

Berkeley SafeTREC

SAFE TRANSPORTATION RESEARCH AND EDUCATION CENTER

(SAFETREC)

UNIVERSITY OF CALIFORNIA, BERKELEY

About the Safe Transportation Research and Education Center (SafeTREC)

Founded in 2000, SafeTREC is part of the University of California, Berkeley, affiliated with the School of Public Health and the Institute of Transportation Studies, with additional partnerships with the Department of City and Regional Planning, Public Policy, and Transportation Engineering. SafeTREC helps the California Office of Traffic Safety (OTS) administer its Community Pedestrian and Bicycle Safety Training workshops and support various safety initiatives from other California agencies, including the California Department of Transportation (Caltrans), by providing programs such as:

- Community Pedestrian and Bicycle Safety Program
- Complete Streets Safety Assessments
- Global Road Safety
- Tribal Road Safety
- Collaborative Sciences Center for Road Safety

SafeTREC's mission is to reduce transportation-related injuries and fatalities through research, education, outreach, and community service.

Berkeley SafeTREC

2614 Dwight Way
Berkeley, CA 94720-7374

safetrec@berkeley.edu
www.safetrec.berkeley.edu