Berkeley SafeTREC

Humboldt County – Community of Loleta Complete Streets Safety Assessment

Issues, Opportunities, and Suggested Strategies

PS-24048

Final Report

September 2024

This report was produced in cooperation with the County of Humboldt and Community of Loleta. 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.

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271
LOLETA POST OFFICE
CRAB PARK
EEL RIVER
BUDUWALHAT LOLETA

LIST OF ABBREVIATIONS

ATA:	Active Transportation Assessment
BAC:	Blood Alcohol Concentration
CIM:	Crash Investigation Manual
CLEC:	California Law Enforcement Challenge
CHP:	California Highway Patrol
CAMUTCD:	California Manual on Uniform Traffic Control Devices
DAR:	Drug alcohol recognition
DRE:	Drug recognition expert
DUI:	Driving Under the Influence
GIS:	Geographic Information System
LTAP:	Local Technical Assistance Program
MOU:	Memorandum of Understanding
MPO:	Metropolitan Planning Organization
NHTSA:	National Highway Traffic Safety Administration
OTS:	Office of Traffic Safety
PCF:	Primary Crash Factor
PDO:	Property Damage Only
PIO:	Public Information Officer
POST:	Peace Officer Standards and Training
RMS:	Record Management System
RTPA:	Regional Transportation Planning Authority
RV:	Recreational Vehicle
SFST:	Standard Field Sobriety Test
SR:	State Route
SWITRS:	Statewide Integrated Traffic Records System
TOF:	Traffic Offender Fund
TTSA:	Tribal Transportation Safety Assessment
CVC:	California Vehicle Code

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ACKNOWLEDGMENTS

The CSSA team thanks Humboldt County agency staff and Loleta community members who provided invaluable contributions to the benchmarking review and field audit to make the Complete Streets Safety Assessment in this community a success. Their knowledge and insight were instrumental to the completion of this project.

Loleta community members and county staff providing local knowledge and sharing safety concerns during the field audit.

DISCLOSURES

This report was developed with the best information available to the authors at that time.

The report summarizes crash data reported in the Statewide Integrated Traffic Records System (SWITRS) retrieved from the Transportation Injury Mapping System (TIMS). The current version of 2022 and 2023 SWITRS data is provisional and is subject to change when it is finalized.

The benchmarking analysis aims to provide Humboldt County with information on current best practices and how Loleta compares. Counties have differing physical, demographic, and institutional characteristics that may make certain goals or policies more appropriate in some jurisdictions than others. Ultimately, county staff will need to determine where resources and efforts are best placed for meeting local development and infrastructure goals for people walking and biking.

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

As this report is conceptual in nature, conditions may exist in the focus areas that were not observed and may not be compatible with recommendations in this report. Before finalizing and implementing any physical changes, staff may need to conduct more detailed studies or further analysis to refine or discard the recommendations 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, high speeds, physical limitations on space or sight distance, or other potential safety concerns.

EXECUTIVE SUMMARY

Humboldt County and the Community of Loleta requested requested that the Safe Transportation Research and Education Center at the University of California, Berkeley, conduct a Complete Streets Safety Assessment (CSSA) study. The objective of the CSSA is to help communities identify and implement traffic safety solutions that lead to improved safety and accessibility for all users, especially people walking and biking, on California's roadways.

The main goal of the CSSA in Loleta was to assess Loleta Drive to improve pedestrian access and identify safe routes to school from downtown Loleta to Loleta Elementary School. Humboldt County staff, community members, and the CSSA team conducted a CSSA field audit on April 15, 2024 to prepare this report.

The report is organized into the following chapters:

1. Introduction
2. Safe System Approach
3. Background and Crash History
4. Benchmarking Analysis Results and Suggested Enhancements
5. Complete Streets Field Audit Results and Near- and Long-Term Suggestions for Safety Improvements

Background

Loleta is a Census Designated Place (CDP) located in Humboldt County, approximately 15 miles south of the City of Eureka with a population of approximately 828. Among its residents, the majority, 72% percent, identify as White, and about 18% identified as Hispanic or Latino.[1] Between 2019 and 2023, two crashes involving pedestrians or bicyclists occurred in Loleta, but no fatal or serious injury crashes. Both crashes occurred on Eel River Drive, a state road. During this same five-year period, 394 crashes involving pedestrians or bicyclists took place in Humboldt County, including 33 fatal crashes and 128 serious injury crashes. Of these 394 crashes, 70% occurred on local roads and 30% occurred on state highways.

The Safe System Approach

The U.S. Department of Transportation, California Department of Transportation, and California Office of Traffic Safety have all adopted the Safe System Approach. The Safe System Approach considers five elements of a safe transportation system — safe road users, safe vehicles, safe speeds, safe roads, and post-crash care — in an integrated and holistic manner. Creating a Safe System means shifting a major share of the responsibility from individual road users to those who design, operate, and maintain the transportation network. The Safe System Approach anticipates human mistakes by designing and managing road infrastructure to keep the risk of mistakes low, and if a mistake does lead to a crash, reducing the impact to the human body to limit the potential for fatality or serious injury.

[1] QuickFacts. United States Census Bureau. Retrieved from https://www.census.gov/quickfacts/fact/table/

The CSSA project team identified Loleta Drive for a comprehensive walk audit based on crash history and conversations with the applicant to understand local safety concerns. During the field assessment, the CSSA project team integrated Safe System elements into a discussion with participants to consider various safety improvements at the study locations. To develop comprehensive recommendations that address the Safe System Approach, the CSSA project team also reviewed responses from local agency staff to the benchmarking assessment, especially those related to local plans and policies that are already in place or underway.

The CSSA focuses primarily on infrastructure-related countermeasures, with an emphasis on improving the safety of people walking and biking. Prioritizing safe target speeds and changing road geometry to manipulate crash angles can help reduce the risk of fatal and severe injuries.

Through the benchmarking assessment, the CSSA team also provides some non-infrastructure insight on safety countermeasures such as education, outreach, and post-crash care. All elements of the Safe System Approach can be applied to corridor and intersection studies moving forward to create an approach that creates layers of protection for all road users.

Benchmarking Analysis and Potential Improvements

Benchmarking analysis is a tool to assess pedestrian and bicyclist safety conditions and to understand how a city or county's existing conditions compare to current best practices. Through a pedestrian and bicycle safety assessment, the CSSA team could identify the local agency's active transportation policies, programs, and practices. While suggestions are provided, counties or local agencies have differing physical, demographic, and institutional characteristics that may make certain goals or policies more appropriate in some jurisdictions than others. Ultimately, county or local agency staff may determine where resources and efforts are best placed for meeting local development and infrastructure goals for pedestrians.

General suggestions for potential improvement or further enhancement to County of Humboldt and Community of Loleta programs and policies are presented in Chapter 4.

Complete Streets Audit and Potential Improvements

Loleta Drive between Main Street and Shadowbrook Street was studied with a focus on Safe Route to School (SRTS) access to Loleta Elementary School. Positive practices, as well as pedestrian and bicycle safety and accessibility issues were identified during the field audit.

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 county, identify, and prioritize capital improvement projects.

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

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, county 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 Complete Streets Safety Assessment (CSSA) is a statewide program of the University of California, Berkeley Safe Transportation Research and Education Center (SafeTREC). Through this program, the CSSA project team conducts crash data analysis, a benchmarking review of local policies, programs and practices, and a transportation safety assessment of select sites to identify safety improvements that align with the Safe System Approach. The objective of the CSSA is to improve safety and accessibility for all people walking and biking in their communities.

The Community of Loleta in unincorporated Humboldt County requested a CSSA to study the Loleta Drive corridor. The Loleta Chamber of Commerce and the County of Humboldt requested a CSSA to improve safety and accessibility for all people walking and biking in Loleta. They were also interested in identifying safe routes to school for youth and their families. This assessment emphasizes safety and mobility issues associated with pedestrians and bicyclists, including a focus on older and younger road users.

The CSSA project team conducted a kickoff virtual meeting with local staff on April 2, 2024 to better understand the community's needs. The CSSA project team conducted a site visit with local staff on April 15, 2024 to observe and document field conditions. Participants included staff from various departments. Following the field audit, the CSSA project team shared preliminary recommendations for site-specific improvements based on their observations and current best practices for designing for people walking and biking.

This report provides an overview of the Safe System Approach and summarizes the findings of the crash data assessment, the benchmarking analysis, and the observations and recommendations from the field audit. Additionally, this report includes four appendices covering pedestrian and bicyclist improvement options, a resource list, and street connectivity.

Figure 1-1: View of Loleta Drive traveling west towards downtown Loleta

2. SAFE SYSTEM APPROACH

2.1. BACKGROUND

Traffic crashes can irreversibly change the course of human lives, affecting victims, their families and loved ones, and society overall. The costs of traffic crashes include substantial economic and societal impacts, such as medical costs, lost productivity, and reduced quality of life. Cities, counties, and tribes need to work to solve the complex problem of traffic safety in their communities to reduce the number of injuries and deaths. The Complete Streets Safety Assessment (CSSA) program provides an opportunity to integrate the Safe System Approach (SSA) into programs, policies, and design decisions related to active transportation improvements to address the underlying road safety concerns in communities statewide. Moreover, the goal of a Complete Street is to ensure the safe and adequate accommodation of all road users.

The Safe System Approach to road safety began internationally as part of the Vision Zero proclamation that no one should be killed or seriously injured on the road system.[2, 3] It is founded on the principle that people make mistakes and that the road system should be adapted to anticipate and accommodate human mistakes and the physiological and psychological limitations of humans.[4] The Safe System Approach acknowledges the vulnerability of the human body — in terms of the limited amount of kinetic energy transfer a body can withstand — when designing and operating a transportation network to minimize serious consequences of crashes, and ensures that if crashes occur, they "do not result in serious human injury."[5] The ability to implement the Safe System Approach across all sectors may vary by local jurisdiction based on the commitment of the agencies involved and their available resources.

Countries that have adopted the Safe System Approach have had significant success reducing highway fatalities, with reductions in fatalities between 50% and 70%.[6] The Safe System Approach is the foundation for the National Roadway Safety Strategy released by the United States Department of Transportation in 2022. Statewide, the California Office of Traffic Safety and Caltrans have both adopted the Safe System Approach and a Vision Zero goal for road safety planning. The principles and elements of the Safe System Approach are shown in Figure 2-1.

[2] Johansson, R. (2009). Vision Zero - Implementing a policy for traffic safety. *Safety Science*, 47, 826-831.

[3] Tingvall, C., & Haworth, N. (1999). *An Ethical Approach to Safety and Mobility*. Paper presented at the 6th ITE International Conference Road Safety and Traffic Enforcement. 6-7 September 1999, Melbourne, Australia.

[4] Belin, M.-Å., Tillgren, P., & Vedung, E. (2012). Vision Zero - a road safety policy innovation. *International Journal of Injury Control and Safety Promotion*, 19, 171-179.

[5] World Health Organization (2011). Retrieved on: June 3, 2024 Decade of Action for Road Safety 2011-2020 (PDF).

[6] World Resources Institute (2018). Sustainable and Safe: A Vision and Guidance for Zero Road Deaths. Retrieved on June 3, 2024 https://www.wri.org/publication/sustainable-and-safe-vision-and-guidance-zero-road-deaths

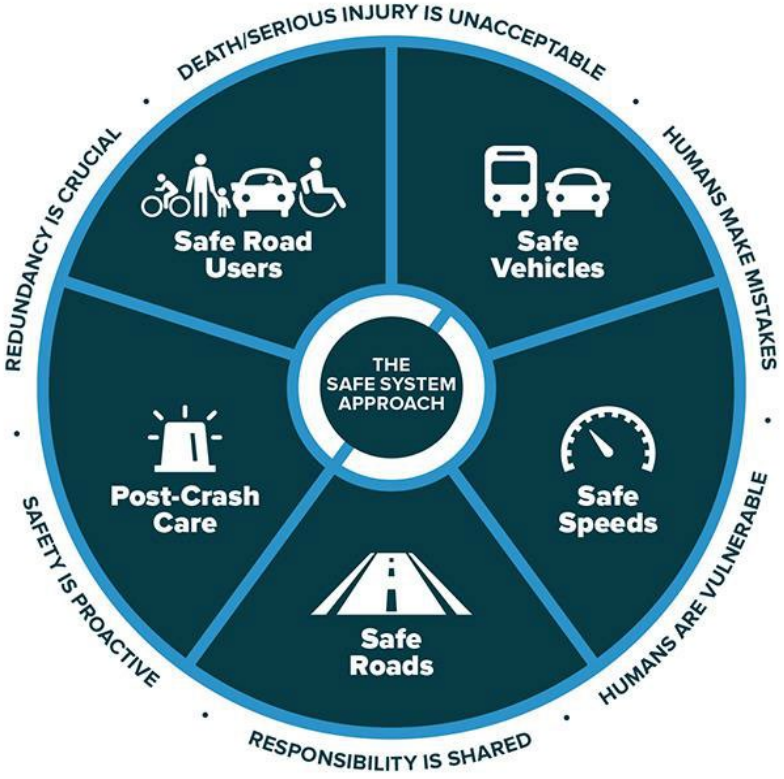


Figure 2-1: U.S. Department of Transportation Safe System Approach Graphic

Preliminary Statewide Integrated Traffic Records System (SWITRS) crash data for 2022 suggests that traffic crashes caused nearly 4,500 preventable deaths and over 200,000 injuries in California. People walking, biking, and rolling are especially vulnerable to death or serious injury when a crash occurs. Through collective action on the part of all roadway system stakeholders — from traffic engineers, planners, public health professionals, and vehicle manufacturers to law enforcement and everyday users — a Safe System Approach can be established to anticipate human mistakes, with the goal of eliminating fatal and serious injuries for all road users.

2.2. INFLUENCE ON ROADWAY DESIGN AND OPERATION

Kinetic energy has long been identified as the cause of injury, such that if a crash occurs, the peak forces at the point of contact determine the degree of injury.[7] [8] [9] Managing the forces of kinetic energy to a level that the human body can tolerate is critical to the Safe System Approach.[10]

[7] Haddon, W. (1980). Advances in the epidemiology of injuries as a basis for public policy. Public Health Reports, 95(5), 411–421.

[8] De Haven, H. (1942). Mechanical analysis of survival in falls from heights of fifty to one hundred and fifty feet. Reproduced in Injury Prevention, 6(1), 62–68 (2000).

[9] Gangloff, A., 2013. Safety in accidents: Hugh DeHaven and the development of crash injury studies. Technol. Cult. 54 (1), 40–61.

[10] Tools like the Safe System Project-Based Alignment Framework developed by the Federal Highway Administration provide practitioners to assess and compare roadway locations and potential improvements through a SSA lens.

In the transportation system, kinetic energy risk is present based on three factors:

1. Exposure: the presence (or potential presence) of two or more users or a user and a fixed object
2. Likelihood: the chance that a conflict occurs between those users/objects based on roadway design, intersection control, or other contextual conditions
3. Severity: the intensity of the energy should the conflict occur (driven by speed, mass, and angle), which is not mitigated by other factors (such as in-vehicle occupant protection)

Systemic assessments of roadway networks can identify and proactively address when these risk factors are high, meaning the consequence of a mistake could be severe.

The Institute of Transportation Engineers (ITE) and the Road to Zero Coalition state that to anticipate human mistakes, best practices for a Safe System seek to:

- Separate users in a physical space (e.g., sidewalks, dedicated bicycle facilities)
- Separate users in time (e.g., pedestrian scrambles, dedicated turn phases)
- Alert users to potential hazards
- Accommodate human injury tolerance through interventions that reduce speed or impact force.

Recent guidance from the Federal Highway Administration (FHWA) characterizes engineering and infrastructure countermeasures and strategies along a hierarchy to help transportation practitioners prioritize efforts that will facilitate increased application of the Safe System Approach principles, as seen in Figure 2-2. Specifically, the Safe System Roadway Design Hierarchy breaks down efforts into four tiers and seeks to: (1) eliminate severe conflicts through physical separation; (2) reducing vehicle speed; (3) manage conflicts in time; and (4) increase attentiveness and awareness.[11] The FHWA further clarifies that a combination of strategies from multiple tiers would be the most effective, reinforcing the Safe System principle that redundancy is crucial.

[11] Hopwood, C., Little, K., and D. Gaines. (2024). Safe System Roadway Design Hierarchy: Engineering and Infrastructure-related Countermeasures to Effectively Reduce Roadway Fatalities and Serious Injuries (FHWA-SA-22-069). US Department of Transportation, Washington, D.C.

Figure 2-2: Federal Highway Administration Safe System Roadway Design Hierarchy Graphic

Nearly one in three (31.7% of the total 4,428) traffic fatalities in California in 2022 was associated with excessive speed or traveling at speeds deemed unsafe for the driving conditions.[12] In 2021 through AB43, California authorized local governments to reduce speed limits on many roads, including state highways, in business and residential areas and other roads identified as "safety corridors" without following the "85th percentile rule" which often caused transportation agencies to raise speed limits. This new authority aligns with the Safe System approach and allows local jurisdictions to target speeds based on user context. Moreover, Caltrans issued Design Information Bulletin (DIB) 94 in 2024 related to "complete streets," which provides local agencies more flexibility to design context-sensitive facilities to better serve the needs of all travelers, including guidance for selecting treatment tools based on speed and volume context.

For vulnerable users, such as people walking, biking, or otherwise not in a vehicle, speed is a determining factor in survivability. Figure 2-3 illustrates how a person's chance of surviving being struck by a vehicle increases as speed decreases: from 10% at 40 miles per hour (mph) to 50% at 30 mph, and 90% at 20 mph. Furthermore, as drivers increase the speed of the vehicle, their peripheral vision narrows. This results in decreased depth perception and a reduced ability to perceive others on the road, such as people walking and biking. Reducing speed in the presence of vulnerable users is a key Safe System strategy.

[12] National Highway Traffic Safety Administration (2023). *Traffic Safety Facts: California 2018-2022.*

Approaches to reducing speed include:

- Physical roadway designs (width, horizontal alignment) to limit speeds
- Traffic calming treatments that induce slower speeds
- Traffic signal timing that minimizes high-speed flow
- Traditional or automated enforcement[13] that discourages speeding

Figure 2-3: Speed and Crash Survivability Graphic. Increasing driver vehicle speed reduces vulnerable road user crash survivability and narrows the driver's field of vision.

Many traffic safety efforts continue to lean on individuals to "do the right thing" to stay safe rather than apply lessons learned from the public health sector to invest in systemwide safety interventions. Ederer (2023) proposed the Safe Systems Pyramid,[14] seen in Figure 2-4, which acknowledges kinetic energy as the root cause of injury and introduces a public health-based intervention framework to address this cause with strategies that require the least individual effort and have the broadest population impact. For example, interventions that require more individual effort (e.g., driver education programs, educational campaigns) have the least impact on improving systemwide safety, while those that change the context of transportation have the largest impacts on safety (e.g., affordable housing near transit, zoning reform). This framework provides guidance when transportation decision-makers cannot do it all, giving priority to projects and interventions that will most impact safety outcomes.[15]

[13] Assembly Bill (AB) 645 was signed into law in October 2023 authorizing six California cities (Glendale, Long Beach, Los Angeles, Oakland, San Francisco, and San Jose) to pilot automated speed cameras for five years.

[14] Ederer, D., Thompson Panik, R., Botchwey, N., & Watkins, K. (2023). Adaptation of the Health Impact Pyramid into the Safe System Pyramid. *Transportation Research Interdisciplinary Perspectives. Vol. 21.* https://doi.org/10.1016/j.trip.2023.100905.

[15] Mitman, M. et al, (2024). Why and How to Focus on Kinetic Energy Risk, *ITE Journal: The Journey to Safer Communities.* 39-45. https://ite.ygsclicbook.com/pubs/itejournal/2024/march-2024/live/index.html#p=38

Figure 2-4: The Safe Systems Pyramid adapts public health principles, like the Health Impact Pyramid and Hierarchy of Controls, to more fully address roadway safety needs.

Strategies at the base of the Safe Systems Pyramid, above, focus on reducing and limiting exposure upstream that affects where, when, and how people enter the transportation system and become exposed to risk. This includes Vehicle Miles Traveled (VMT) mitigation, in terms of both the duration of travel as well as the location and mode. Middle-of-the-pyramid strategies seek opportunities, on top of exposure mitigation, to limit conflicts through the separation of users in space and time, and limit severity through speed management and reduced angles of crashes. Less preferred strategies in this framework focus on educational interventions that are conditional on individual behavior change. In alignment with the SSA, education can be effective when combined with efforts from other tiers in the pyramid to strengthen redundancies.

Conventional safety practice is primarily reactive, largely based on data provided to engineers and planners in crash reports. However, the primary purpose of crash reports is to document the moment of the crash and the time immediately preceding it to determine “fault” across the involved parties (such as needed for insurance claims). As a result, it shifts the responsibility for the crash to an individual, rather than assessing opportunities to intervene at the system level. The Safe Systems Pyramid recommends focusing on root causes of the crash by considering the Ws of safety:

- Who was involved; what is their personal story?
- Where were they traveling from and to? Why were they on this road?
- Why were they traveling on that day, at that time?
- Why did they use their selected travel mode?
- Why was the road they were traveling on designed the way it is?

Creating a Safe System means shifting a major share of the responsibility from individual road users to those who design the road transport system. “Individual road users have the responsibility to abide by laws and regulations”[16] and do so by exhibiting due care and proper behavior in the transportation system. While road users are responsible for their own behavior, a Safe System requires a shared responsibility with those who design, operate, and maintain the transportation network, including the automotive industry, law enforcement, elected officials, and government bodies.[17] In a Safe System, roadway system designers and operators take on the highest level of ethical responsibility to look at crashes holistically and systemically, and recognize that crashes are not only caused by a driver’s error.

2.3. INTEGRATING THE SAFE SYSTEM APPROACH INTO THE CSSA

The Safe System Approach involves anticipating human mistakes by designing and managing road infrastructure to keep the risk of such mistakes low, and if a mistake does lead to a crash, reducing the impact to the human body and the likelihood of fatality or serious injury. The first step in incorporating the Safe System Approach into the CSSA is a benchmarking analysis. The benchmarking analysis, based on the Safe System elements, evaluates the local agency’s programs and policies and how their existing efforts incorporating best practices related to access and comfort for people walking and biking compare with national best practices. The aim is to fully institutionalize the SSA in the local agency’s program, practices, and policies, rather than on a case-by-case basis, and by identifying and removing barriers to its adoption.

The applicant and CSSA project team identified focus areas (i.e., intersections and corridors) to conduct a comprehensive walk audit based on crash history and conversations with the applicant to understand local safety concerns. During the field assessment, the CSSA project team integrated the Safe System elements into a discussion with participants to prompt safety improvements at the study locations, considering the “Ws” of safety noted above.

The CSSA field assessment focused primarily on infrastructure-related countermeasures, with an emphasis on improving the safety of people walking and biking. Specifically, the CSSA seeks to reduce speeds to a target speed for the road context, separate road users in space and time for that context, and change road geometry to manipulate crash angles as proactive strategies to address kinetic energy risk for fatal and serious injuries.

This CSSA report compiles a set of considerations for the local agency to both institutionalize a Safe System Approach into programs, practices, and policies, and to directly apply the SSA lens through field assessments and countermeasure selection.

[16] World Health Organization (2011). Decade of Action for Road Safety 2011-2020. Retrieved on: June 3, 2024 *Decade of Action for Road Safety 2011-2020* (PDF).

[17] World Health Organization (2011). Decade of Action for Road Safety 2011-2020. Retrieved on: June 3, 2024 *Decade of Action for Road Safety 2011-2020* (PDF).

3. BACKGROUND AND CRASH HISTORY

Loleta is a Census Designated Place (CDP) located in Humboldt County, approximately 15 miles south of the City of Eureka, and has a population of approximately 828. According to the United States Census Bureau, the CDP has a total area of 2.125 square miles (5.504 km^2). Among its residents, the majority, 72% percent, identify as White, and about 18% identified as Hispanic or Latino.[18] The median household income in Loleta in 2022 was $69,318, lower than the statewide median household income of $91,551.[19] Humboldt County had an estimated daily vehicle miles traveled on local roads of 3,525,067 in 2021.[20] The vicinity of Loleta is shown in Figure 3-1.

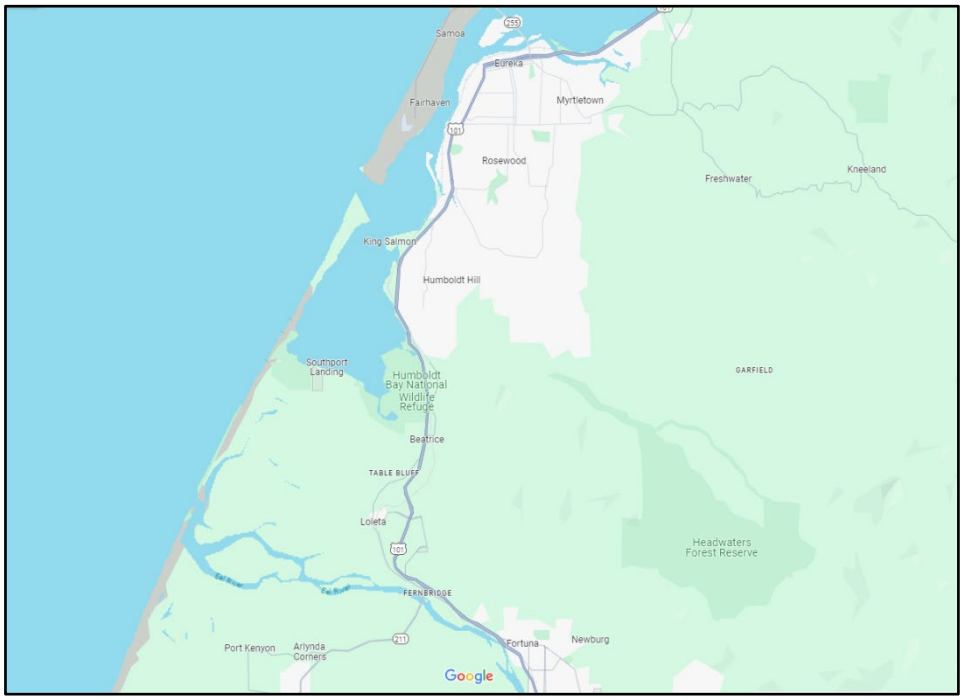


Figure 3-1: Loleta Vicinity Map

3.1. OVERVIEW OF PEDESTRIAN AND BICYCLIST SAFETY

One of the goals of the Complete Streets Safety Assessments is to make walking and biking safer and more accessible for all residents and visitors in Loleta. This section presents a summary of traffic crashes by statewide ranking, in addition to detailed analyses of crashes involving pedestrians and bicyclists to determine high-risk groups. High-priority crash locations and unsafe behaviors are also identified, and the importance of underreported and near-miss crashes is discussed.

[18] QuickFacts. United States Census Bureau. Retrieved from https://www.census.gov/quickfacts/fact/table/

[19] Profiles. United States Census Bureau. Retrieved from https://data.census.gov/profile/

[20] California Office of Traffic Safety. OTS Crash Rankings. Retrieved from https://www.ots.ca.gov/media-and-research/crash-rankings/.

Office of Traffic Safety Ranking for Pedestrian and Bicycle Crashes

The California Office of Traffic Safety (OTS) maintains crash rankings to facilitate comparison between cities with populations of similar size and to identify and address potential emerging or ongoing traffic safety issues. The rankings are based on the Empirical Bayesian (EB) Ranking Method that gives weights to many different factors, such as population, vehicle miles traveled, and crash counts. Rankings are available for incorporated cities and only includes local streets and state highways within the city limits. Counties are also assigned a statewide ranking. Data for the OTS rankings are taken from the Statewide Integrated Traffic Records System (SWITRS), the California Department of Transportation, and the California Department of Finance.

OTS crash rankings are only indicators of potential problems and there are many external factors that may either understate or overstate a city's ranking. According to OTS rankings, in 2021, Humboldt County was ranked 43 out of 58 counties for people killed or injured in a traffic crash (with a ranking of "one" indicating the worst). For pedestrians and bicyclists killed or injured in a crash, Humboldt County ranked 13/58 and 30/58, respectively. Humboldt County ranked 18/58 for drinking and driving between the ages of 21 and 34, and 23/58 for nighttime (9 p.m. - 3 a.m.) crashes.

3.2. PEDESTRIAN AND BICYCLE CRASH DATA

Crash data is vital to compete for funding at the state and federal levels to implement safety improvements. The Statewide Integrated Traffic Records System (SWITRS) maintained by the California Highway Patrol is the state's official traffic records database. It captures reported crashes that resulted in injury or death. The 2022 SWITRS data used is provisional as of June 2024 and subject to change before it is finalized. The CSSA team retrieved SWITRS crash data for the City of Adelanto from the Transportation Injury Mapping System (TIMS) database for 2019 through 2023. TIMS is a tool developed by SafeTREC to provide quick, easy, and free access to SWITRS which has been geo-coded by SafeTREC to make it easy to map crashes. The data presented below includes police-reported crashes that occurred within Loleta CDP limits and for Humboldt County.

During this five-year period from 2019 to 2023, two crashes involving pedestrians or bicyclists occurred in Loleta, but no fatal and serious injury crashes. Both crashes occurred on a state road, Eel River Drive.

During the same five-year period, 394 crashes involving pedestrians or bicyclists took place in Humboldt County, including 33 fatal crashes and 118 serious injury crashes. Of these 394 crashes, 70% occurred on local roads, and 30% occurred on state highways.

Pedestrian Crashes

Between 2019 and 2023, there were 17 crashes involving pedestrians in Humboldt County. Among the 248 victims of these crashes, 27 people were killed and 86 people were seriously injured. The majority (52%) of pedestrian crashes resulted in minor injury.[21] The majority (81%) of victims were under age 54, including school-age youth ages 5-18, who accounted for 7% of victims. Age ranges 30-34 and 45-59 experienced the highest number of crashes overall, at approximately 12% each. The top Primary Collision Factor (PCF) violations include pedestrian right-of-way (33%) and pedestrian violation (35%), followed by improper turning (7%) and unsafe speed (6%). Figure 3-2 shows the spatial distribution of pedestrian crashes by severity in Humboldt County. Fatal and serious injury crashes were distributed primarily along US-101.

[21] Minor injury is the sum of two victim degree of injury categories: suspected minor injury and possible injury.

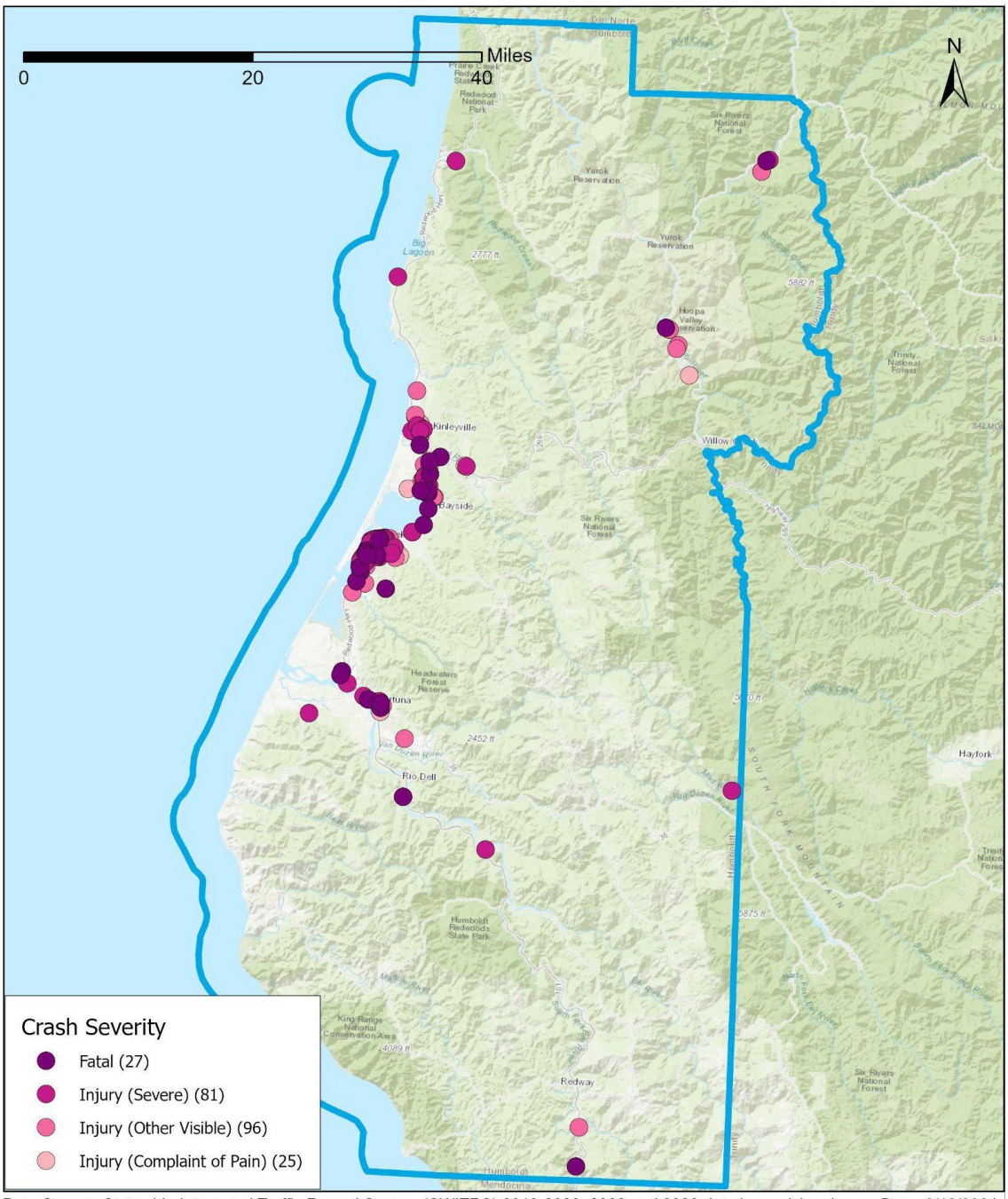


Figure 3-2: Map of Pedestrian Crashes in Humboldt County (2019-2023)

Figure 3-3 and Figure 3-4 show an analysis of pedestrian-related crashes in Humboldt County.

Figure 3-3 shows the distribution of when pedestrian crashes occurred in Humboldt County. The majority of crashes occurred during the window between 12 p.m. and 9 p.m. Monday to Saturday, with the highest number of crashes occurring between 3 p.m. and 6 p.m. on Tuesday. Almost half (49%) of the pedestrian crashes occurred in daylight, the remaining 45% occurred in the dark. Of the crashes that were in the dark, thirty-two crashes occurred where there were no street lights or the street lights were not functioning.

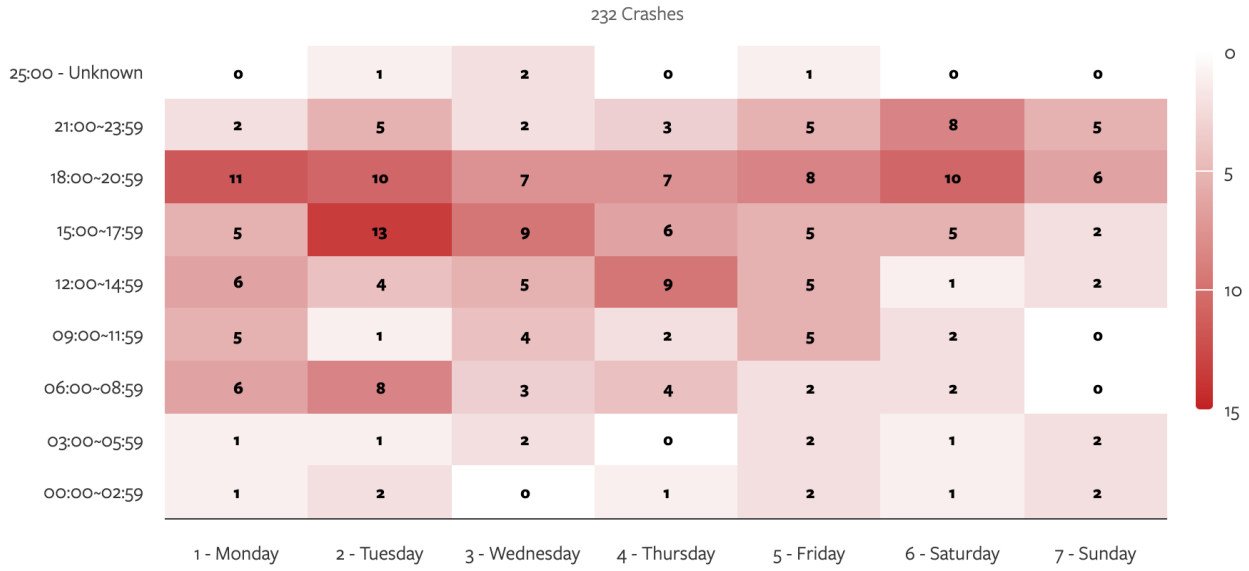


Figure 3-3 Pedestrian Crashes by Day of Week and Time of Day in Humboldt County (2019-2023)

Figure 3-4 shows the distribution of crashes by pedestrian action in Humboldt County. The majority of pedestrian crashes, 67%, occurred when crossing the street. Of the remaining crashes, 23% occurred on the road and 8% occurred not in the road.

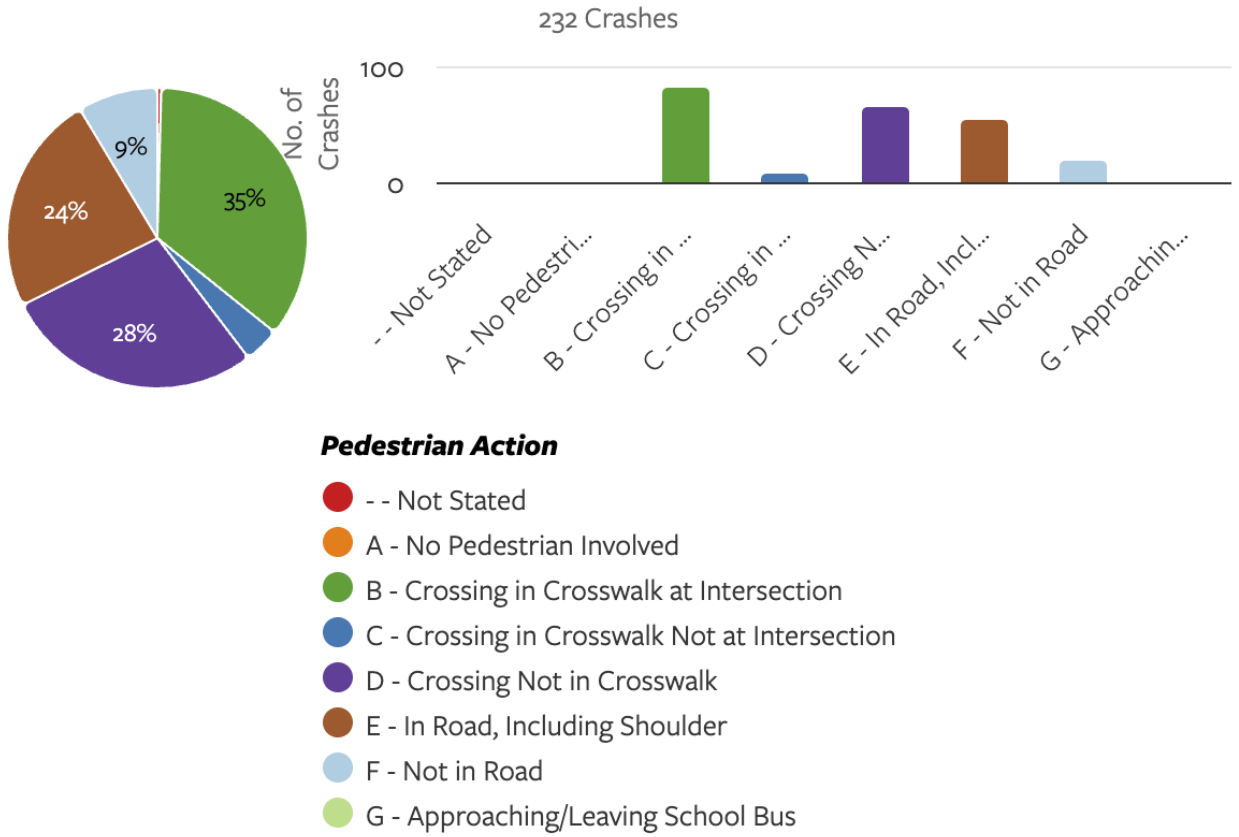


Figure 3-4: Pedestrian Crashes by Pedestrian Action in Humboldt County (2019-2023)

Bicycle Crashes

Within the five-year period of data analyzed from TIMS, a total of 162 crashes involving bicycles in Humboldt County. Among the 163 victims of these crashes, six people were killed and 35 people were seriously injured. The majority of bicycle crashes resulted in minor injury at 74% of total crashes. Approximately 73% of bicycle crash victims were male. Bicycle crash victims varied in age, with all age groups affected. The most impacted age groups include school-age students (age 5 to 18) at 18% of all victims, and adults between the ages of 19 and 39, at 38% of all victims. The top Primary Collision Factor (PCF) violations were improper turning (21%), automobile right-of-way (19%), wrong side of road (12%), traffic lights and signals (12%) and unsafe speed (12%). Figure 3-5 shows the spatial distribution of bicycle crashes by severity in Humboldt County. Crashes were distributed primarily along US-101.

During the five-year period of data analyzed from TIMS, two crashes involving bicycles occurred in Loleta. Among the two victims of these crashes, no one was killed or seriously injured, and both bicycle crashes resulted in minor injury. One crash victim was between the ages of 40 and 44 and the other was between the ages of 65 and 69. The Primary Collision Factors (PCF) included automobile right-of-way and improper turning. Figure 3.6 shows the spatial distribution of bicycle

crashes by severity in Loleta. Of the two bicycle crashes occurred on Main Street and Cannibal Road, and the other occurred on Eel River Drive, south of Summer Street.

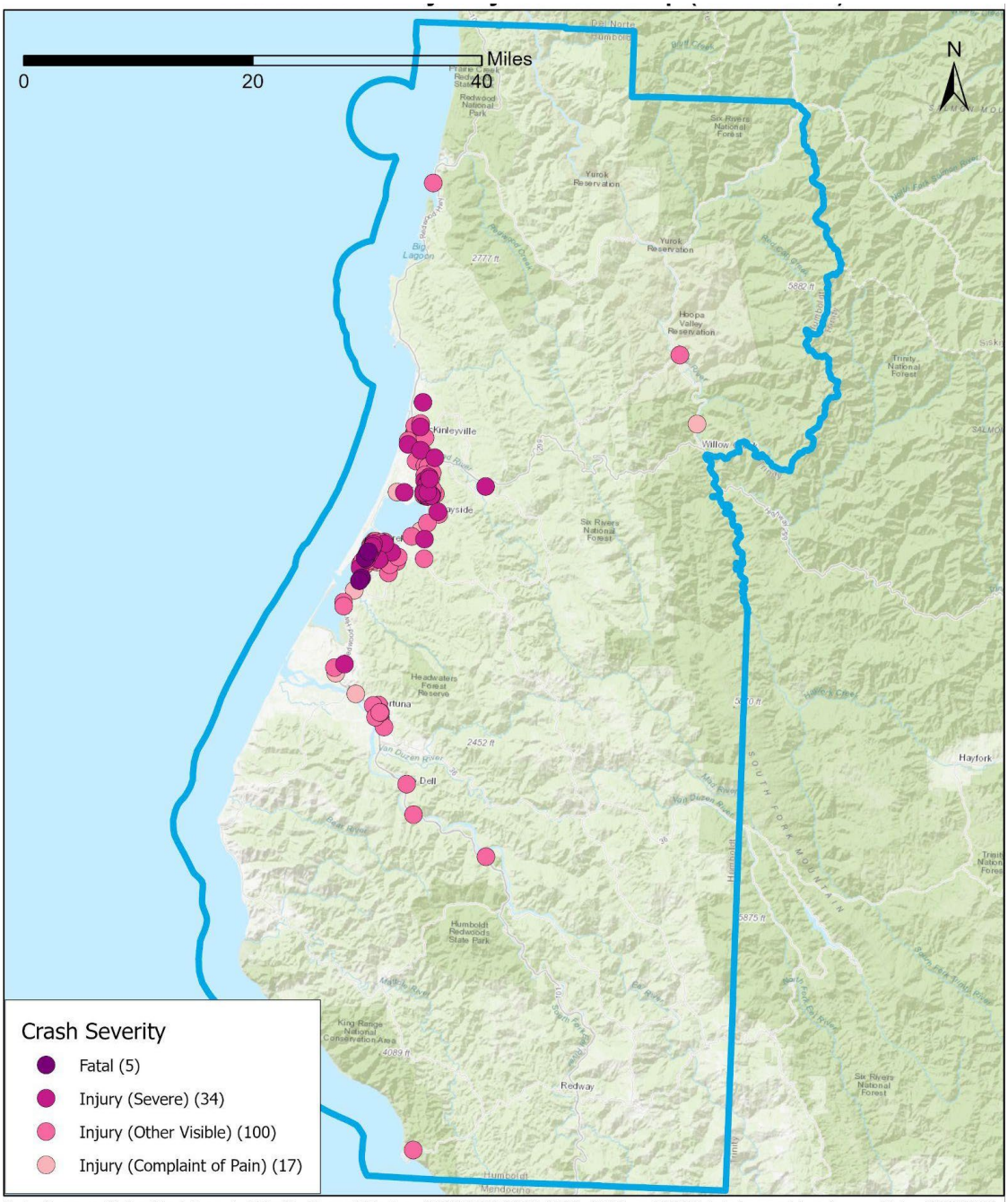
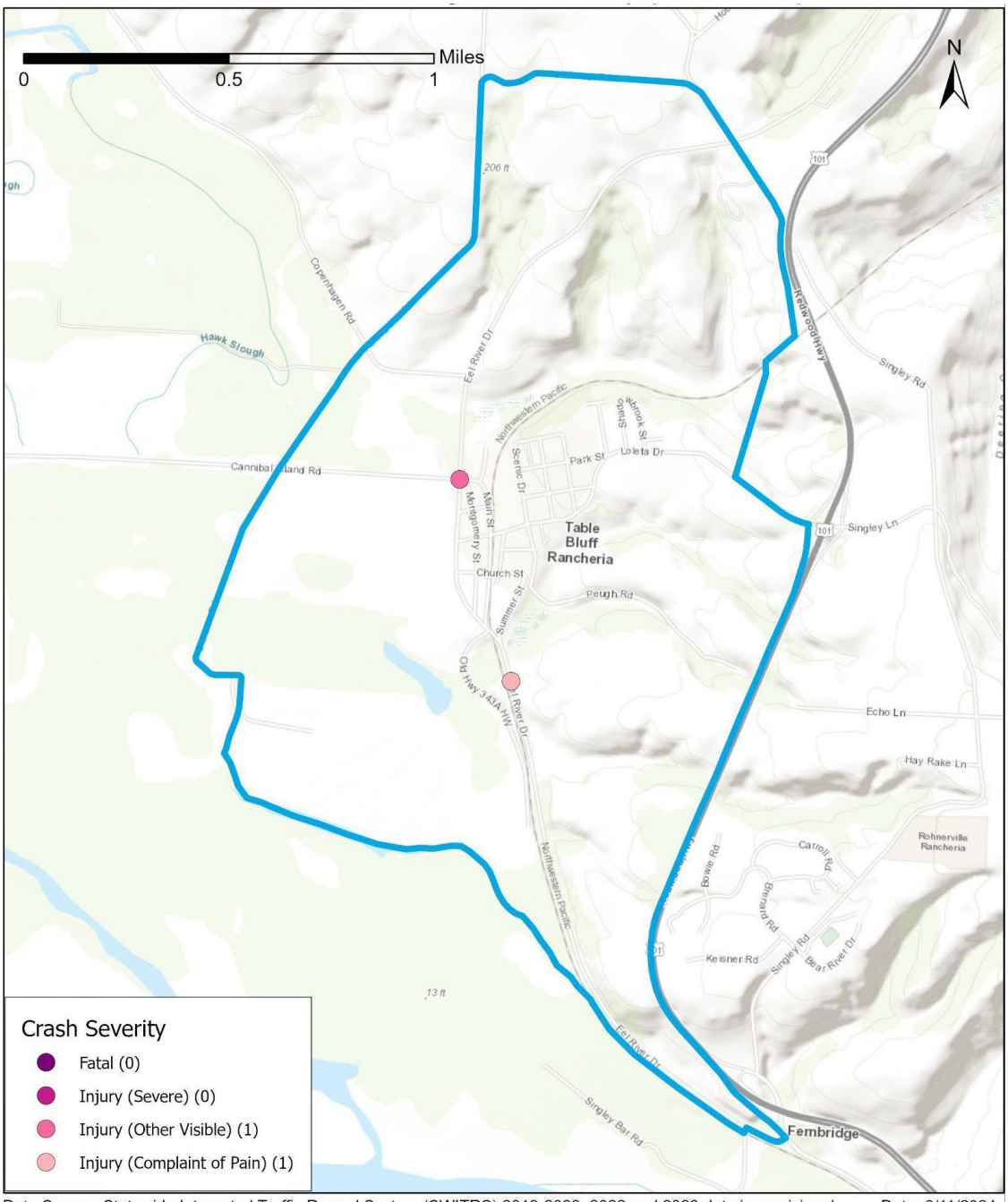


Figure 3-5: Map of Bicycle Crashes in Humboldt County (2019-2023)



Data Source: Statewide Integrated Traffic Record System (SWITRS) 2019-2023; 2022 and 2023 data is provisional as of Jun. 2024

Date: 6/11/2024

Figure 3-6: Map of Bicycle Crashes in Loleta (2019-2023)

Figure 3-7 shows the distribution of bicycle crashes in Humboldt County by the time of day and day of the week. The highest number of crashes occurred Wednesday between 3 p.m. and 6 p.m. Of the two bicycle crashes reported in Loleta, both crashes occurred between 3 p.m. and 6 p.m. on a Monday.

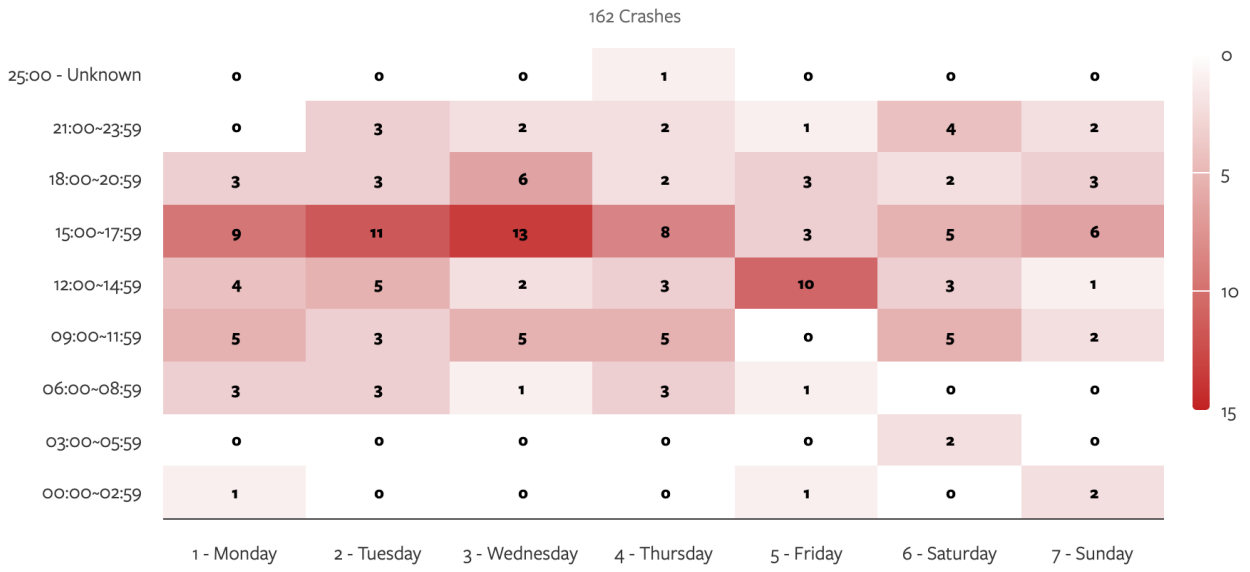


Figure 3-7: Number of Bicycle Crashes by Day of Week per Time in Humboldt County (2019-2023)

Figure 3-8 shows the distribution of where bicycle crashes in Humboldt County by crash type. Nearly 60% of bicycle crashes in Humboldt County were reported as crash type "other," which is standard language for bicycle crashes. Of the remaining bicycle crashes, 14% resulted from vehicle broadside, while 10% resulted from bicycle overturning. In Loleta, one crash occurred as a result of vehicle broadside and the second occurred as a result of a bicycle overturning.

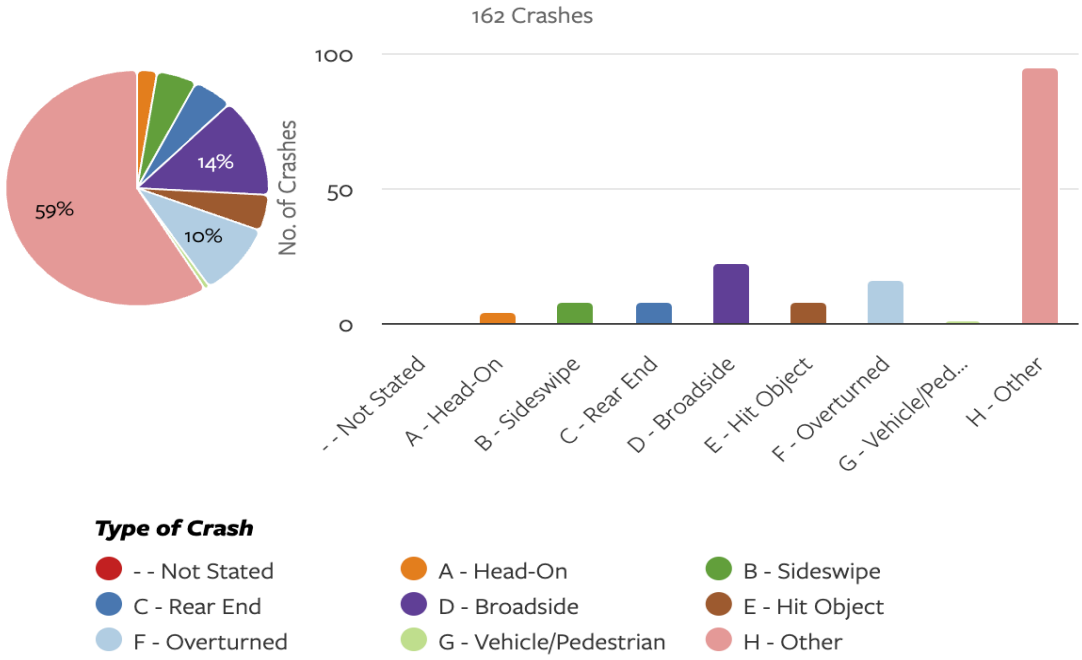


Figure 3-8: Number of Bicycle Crashes by Crash Type in Humboldt County (2019-2023)

3.3. FOCUS AREAS

This study focuses on Loleta Drive, a major east-west corridor through Loleta, providing access to US-101 to the east and Eel River Drive to the west. Loleta Drive runs through downtown Loleta and provides access to Loleta Elementary School. Loleta Drive is a two-lane collector roadway and is designed to serve vehicles, as there are no road facilities for other road users. Between 2019 and 2023, there were no reported pedestrian or bicycle crashes along the focus corridor of Loleta Drive.

3.4. STREET STORY

Despite the best efforts, pedestrian and bicycle crash underreporting is common. Research suggests that a crash is less likely to be reported if there is no injury, little property damage, or only one party is involved.[22, 23, 24] Street Story (https://streetstory.berkeley.edu/) is a crowdsourced community engagement tool developed by UC Berkeley SafeTREC that allows residents, community groups, and agencies to collect information about traffic crashes, near-misses, general hazards, and safe locations to travel. Once a record has been entered, the information is added to a map and aggregate table of publicly accessible data.

Staff can use this free tool to collect information from residents for local needs assessments, transportation safety planning efforts, safety programs, and project proposals. Jurisdictions can create custom boundaries through the Street Story tool to collect data for local needs assessments or to support local traffic safety planning efforts, safety programs, and project proposals.

At the time of this report, 1,195 reports were input in Street Story for Humboldt County. Among those, there were 141 crashes, 413 near-misses, 600 hazards, and 41 safe reports. For hazards, the top reported reasons indicated unsafe speeds, poor/missing bike lanes or paths, drivers not yielding, and poor/missing sidewalks. For crashes/near-misses, the top reported reasons indicated include drivers not yielding, drivers speeding, some other event, or poor/missing bike lanes or paths.

At the time of this report, five reports were input in Street Story for Loleta. Two Street Story reports were for crashes and two were for hazards. Crashes reported on Street Story include one crash on Eel River Drive and Copenhagen Road and one on Eel River Drive and Cannibal Island Road. Hazards reported include two reports of the Park Street and Franklin Avenue intersection being dangerous.

[22] Stutts, J.C. and W.W. Hunter (1998). Police reporting of pedestrians and bicyclists treated in hospital emergency rooms. Transportation Research Record J. Transportation Research Board. 1998 (1635), 88-92. Available at: https://safety.fhwa.dot.gov/ped_bike/docs/00144.pdf

[23] Sciortino, S. et al. (2005). San Francisco pedestrian injury surveillance: mapping, under-reporting, and injury severity in police and hospital records. Accident Analysis & Prevention, 37(6), 1102-1113. doi: 10.1016/j.aap.2005.06.010

[24] Loo, B.P. and K. Tsui (2007). Factors affecting the likelihood of reporting road crashes resulting in medical treatment to the police. Injury Prevention, 13(3), 186-189. doi: 10.1136/ip.2006.013458

4. BENCHMARKING ANALYSIS RESULTS & SUGGESTED ENHANCEMENTS

To assess pedestrian and bicycle safety conditions in the unincorporated community of Loleta in Humboldt County, the CSSA team conducted a benchmarking analysis to understand how the site's existing conditions compare to current national best practices, including consistency with the Safe System approach. Through a holistic view of first anticipating human mistakes and keeping impact energy levels to the human body at tolerable levels, the Safe System Approach aims to eliminate fatal and serious injuries for all road users.

An electronic questionnaire was sent to the Community of Loleta staff with an optional interview. The benchmarking questionnaire was separated into five categories:

1. Enhancing Safety through Accessibility
2. Policies and Programs
3. Safety Data Collection and Assessment
4. Pedestrian and Bicycle Network Planning and Design
5. Pedestrian and Bicycle Support Programs

Each benchmarking category addresses one or more of the Safe System Approach elements (Safe Road Users, Safe Vehicles, Safe Speeds, Safe Roads, and Post-Crash Care) while also incorporating national best practices related to access and comfort for people walking and biking.

Since this CSSA was not directly conducted for the County of Humboldt, a general discussion of the benchmarking items and suggestions for better aligning each topic with best national practice are also noted for the County of Humboldt and Community of Loleta's staff consideration. However, the local agencies have differing physical, demographic, and institutional characteristics that may make certain goals or policies more appropriate in some jurisdictions compared with others. Ultimately, the local agency's staff may determine where resources and efforts are best utilized to meet local development and infrastructure goals for pedestrians and bicyclists.

4.1. ENHANCING SAFETY THROUGH ACCESSIBILITY

To improve traffic safety, it is important to consider the needs of all road users. This may include removing obstacles that prevent people with disabilities from traveling safely and comfortably by separating users in time and space, designing road networks to make road users more visible, or improving driver education and vehicle technologies. Key areas to consider in this category are safe road users and safe roads.

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. U.S. Access Board Public Right-of-Way Accessibility Guidelines

Suggestions for Potential Improvement

- Continue adding ADA ramps at intersections that currently lack them and upgrade non-compliant ramps.

- Develop an ADA improvement program for items such as dual curb ramps, truncated domes, and audible pedestrian signals that apply consistent treatments. The program may provide an inventory, prioritization plan, and funding source for such improvements.

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 include 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.

Suggestions for Potential Improvement

- Consider prioritizing sub-areas within the city that exhibit the 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.
- Consider having a part-time, trained ADA coordinator to review projects for accessibility and implement the ADA Transition Plan.
- Provide ADA standards and best practice training for engineering staff at all levels.
- Ensure safety for all users is prioritized and accessibility is maintained during construction and road maintenance projects. It is vital to ensure that dedicated space is maintained for vulnerable users during construction and road maintenance projects.
- Create a policy that details how to maintain accessibility and provide designated space for pedestrians and bicyclists through a Construction Management Plan (CMP).

4.2. POLICIES AND PROGRAMS, SAFETY IMPLEMENTATION PLANS AND POLICIES

Policies, programs, and plans play a critical role in keeping people safe on California roadways. Collectively, they signal a proactive approach to identifying risks and strategies to mitigate them.

Key areas to consider in this category are safe road users, safe roads, and safe vehicles.

Transportation 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 crashes.

Suggestion for Potential Improvement

Consider establishing a formal advisory committee with regularly scheduled meetings to bring all transportation projects to the general committee to provide opportunities for focused complete streets discussion.

Traffic Calming or Speed Management Program

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

Suggestions for Potential Improvement

- Increase the amount of dedicated funding available for traffic calming each year.
- Expand the city's traffic calming toolbox to include other tools, such as raised crosswalks, raised intersections, chicanes, and traffic diverters. The city should review their speed management program annually alongside the CIP project list to identify major arterials and neighborhood corridors for proactive speed management.
- Expand city's practices to include proactive traffic calming measures instead of only responding to community requests. The city could consider allocating a portion of funding to proactive traffic calming, such as bicycle boulevard streets or safe routes to schools, then allocate the remaining funding to react to specific community requests.
- The following resources offer traffic calming best practices:
  - Traffic Calming to Slow Vehicle Speeds | US Department of Transportation
  - Traffic Calming Guidelines from the City of Danville (PDF)
  - Neighborhood Traffic Management Program from the City of Anaheim
  - ITE Technical Resources — Traffic Calming Measures

Speed Limit Setting

Agencies should regularly survey speeds and identify locations with high deviations from target speeds. Local municipalities use best practices for speed management from AB 43 to lower speed limits. Implementing lower speed limits is accomplished by using a consistent approach that prioritizes areas with historic underinvestment.

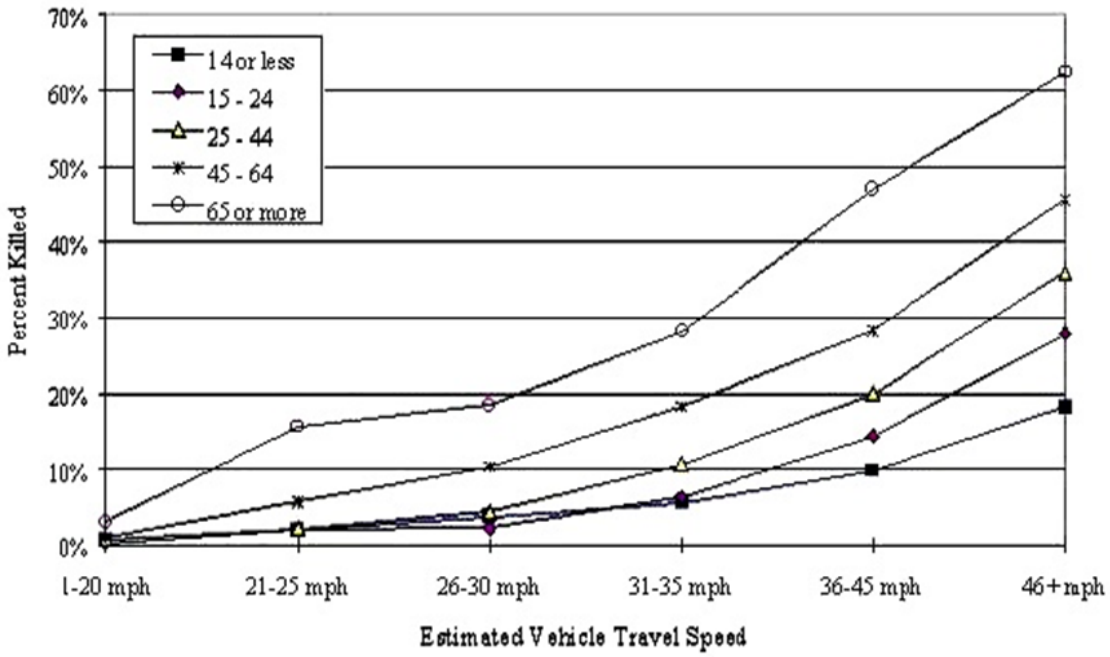


Figure 4-1: Relationship Among Vehicle Speed, Victim Age, and Fatalities

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.
- After complete streets improvement and other safety measures 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 school zones.
- Additional information on AB 43: San Francisco's Speed Limit Setting in Business Districts: News Release: San Francisco Lowers Speed Limits in Targeted Business Districts Under New State Law

Safe Routes to Schools

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 https://www.saferoutesinfo.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 Community of Loleta does not have a Safe Routes to Schools program and has not obtained any recent funding.

Suggestions for Potential Improvement

- Form an steering committee for the program (or each school) composed of city staff, school district staff, PTA leaders, and other stakeholders who meet regularly to monitor efforts and identify new opportunities.
- Consider a Safe Routes to School plan for all schools that are integrated with other policies and programs to conduct walk audits, identify recommended safety improvements, and secure funding for those improvements.

Systemic Signalized Intersection Enhancements

A systemic signalized intersection enhancement program follows a Safe System-based framework and proactively implements FHWA's proven safety countermeasures to manage speed and crash angles and to consider risk exposure. Proven safety countermeasures at signalized intersections include Leading Pedestrian Intervals (LPIs), protected left turns, roundabouts, medians, and countdown signals.

Suggestion for Potential Improvement

Consider establishing a systemic signalized intersection enhancement program that follows a Safe System-based framework. FHWA resources include:

- Federal Highway Administration: Safe System-Based Framework and Analytical Methodology for Assessing Intersections
- Federal Highway Administration: Proven Safety Countermeasures (PDF)
- Federal Highway Administration: Safe Transportation for Every Pedestrian (STEP)
- National Cooperative Highway Research Program: Application of Pedestrian Crossing Treatments for Streets and Highways

Systemic Enhancements for Uncontrolled and Unsignalized Intersection Crossings

A systemic crosswalk enhancement program proactively implements a Safe Transportation for Every Pedestrian (STEP)-consistent countermeasure at uncontrolled crossings.

The Community of Loleta does not have a policy or set practices for addressing crosswalk installation or enhancements using proven safety countermeasures.

Suggestions for Potential Improvement

- Develop a citywide crosswalk policy for the installation, removal, and enhancement of crosswalks at controlled and uncontrolled locations. Ensure that it is consistent with best practices and recent research. This includes removing crosswalks only as a last resort and 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, add them to a prioritized list that will be upgraded over time as funding is available.
- Federal Highway Administration STEP Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations (PDF)

Safe System Policy

A Safe System policy with redundancy built in for transportation projects includes all users and modes, affects new construction and maintenance, considers local context, and provides guidance for implementation.

Suggestion for Potential Improvement

Consider adopting a Safe System Approach, based on the following resources:

- National Safety Council: Safe System Approach
- California Office of Traffic Safety: What is a Safe System Approach
- SafeTREC: Safe System Strategies for Bicyclists and Pedestrians Toolkit (PDF)
- SafeTREC: Conducting Community Engagement with a Safe System Lens (PDF)
- Vision Zero Network: Demystifying the Safe System Approach

- California Active Transportation Safety Information Pages (CATSIP): Safe System Approach to Road Safety
- U.S. Department of Transportation Federal Highway Administration: Zero Death and Safe System
- U.S. Department of Transportation: Safe Streets and Road Users for All (SS4A) Grant Program

4.3. SAFETY DATA COLLECTION AND ASSESSMENT

Collecting and assessing data improves effectiveness, efficiency and overall system performance. Data can inform how to build safer roads for all modes of travel, including walking, biking, rolling, and driving. Key areas to consider in this category are safe road users.

Collection of Pedestrian and Bicyclist Volumes

Pedestrian and bicyclist volume data and a GIS database are important for understanding where people walk and bike. This establishes baseline data prior to project implementation and can help in prioritizing projects, developing crash rates, and determining appropriate bicycle and pedestrian infrastructure. The database helps to identify patterns and needs of underserved communities in local jurisdictions policies and programs.

The community of Loleta does not collect pedestrian and bicycle volumes.

Suggestions for Potential Improvement

- Routinely collect pedestrian and bicycle volumes by requiring them to be counted in conjunction with manual intersection turning movement counts.
- Metropolitan Transportation Commission: Traffic Data Collection in the San Francisco Bay Area (PDF)
- Geocode pedestrian volume data with GIS software along with other data such as pedestrian control devices and crashes to analyze data for trends or hotspots related to pedestrian safety.

Inventory of Bikeways, Parking, Informal Pathways, and Key Bicycle Opportunity Areas

A GIS-based inventory of bikeways, parking, informal pathways, and key bicycle opportunity areas enables project identification and prioritization, as well as project coordination with new development, roadway resurfacing, etc. This data set can be made available on a city's website for knowledge sharing with the public as well as agencies.

Suggestions for Potential Improvement

- Migrate the inventory of bikeways, bike parking, and future bike improvements into a GIS format for quick mapping and sharing.
- Identify a staff person responsible for maintaining the GIS data set.

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, etc. This data set can be made available on a city's website for knowledge sharing with the public as well as agencies.

Suggestions for Potential Improvement

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

Inventory of Traffic Control Equipment (Signs, Markings, and Signals)

Cities have a wide variety of traffic control devices that regulate how bicyclists and pedestrians should use the street and interact safely with drivers. However, some cities do not have inventories of how, when, and where these are installed. Creating a database of this information allows city staff to know where infrastructure may be out of date or in need of updates. For example, countdown signals are an important pedestrian safety countermeasure. The 2012 California *Manual of Uniform Traffic Control Devices* (MUTCD) requires the installation of countdown pedestrian signals for all new signals. The CA MUTCD also requires the installation of bike detection at all actuated signals. Bike detection is a basic building block of the bike network that makes sure that bikes can trigger traffic signals. Inventorying bike detection and countdown signals allows city staff to approach safety from a systems perspective and develop projects to close gaps in biking and walking infrastructure over time.

Suggestions for Potential Improvement

- Develop a city or countywide 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 inventory of signs, markings and signals.
- Develop a proactive monitoring program to ensure the quality and proper functioning of traffic control devices.

Crash History and Crash Reporting Practices

Safety is typically approached through both proactive and reactive measures. Identifying and responding to crash patterns on a regular basis and in real-time 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 systemwide basis. This is often paired with a policy goal of getting to zero fatality or serious injury crashes (commonly referred to as "Vision Zero").

Suggestions for Potential Improvement

- Adopt a data driven systemic safety approach, which would include a systems 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 volume data, the city could prioritize crash locations based on crash rates (i.e., crashes/daily pedestrian volume), a practice that results in a complete safety needs assessment. Treatments could then be identified for each location and programmatic funding allocated in the city's Capital Improvements Program (CIP).

Safety Action Plan

A Local Road Safety Plan (LRSP) or Caltrans-approved safety report identifies dedicated, annual funding streams for bicycle and pedestrian projects within underserved communities. Bicycle and pedestrian projects can also be integrated into the other work that the city does, including repaving and other routine roadway network maintenance.

Dedicated annual funding streams may include general city funds, local and regional impact fees, county tax measure funds, and local tax measure funds. Some grant opportunities include the Highway Safety Improvement Program (HSIP), Congestion Mitigation and Air Quality Improvement Program (CMAQ), Active Transportation Program (ATP), Safe Routes to School Grant (SRTS), TDA Article 3 (SB 821), and Safe Streets for All (SS4A). The community of Loleta does not have an LRSP or other Caltrans-approved safety plan.

Suggestions for Potential Improvement

- Partner 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 development.
- 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.

4.4. PEDESTRIAN AND BICYCLE NETWORK PLANNING AND DESIGN

Safe, comfortable, and connected pedestrian and bicycle networks allow people of all ages and abilities to navigate roads to get where they want to go. Key areas to consider in this category are safe road users and safe roads.

Complete Streets Policy

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.

The community of Loleta does not have a Complete Streets Policy.

Suggestions for Potential Improvement

Consider adopting a Complete Streets Policy. 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:

- Boston, Massachusetts: Boston's Complete Streets
- Philadelphia, Pennsylvania: Philly Free Streets (Facebook)

Active Transportation Plan

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 Plans document 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 community of Loleta does not have an Active Transportation Plan and Pedestrian or Bicycle Master Plan.

Suggestions for Potential Improvement

- Implement the low-hanging projects in the Bicycle and Pedestrian Master Plan 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.
- Develop high injury networks for walking and biking to identify routes with the highest incidences of fatal and severe injuries for pedestrians and bicyclists. This will create a systematic safety analysis that can help in prioritizing limited resources.
- Consider identifying existing and missing bicycle and pedestrian infrastructure for safety improvement.

Existing Bike Network

Innovative features such as protected bikeways, bike boulevards, and protected intersections citywide or countywide 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 of 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.

Suggestions for Potential Improvement

- Continue to identify funding sources and implement the proposed projects identified in the Bicycle and Pedestrian Master Plan.

- Develop design standards for bike boulevards, trails, paths, and landscaping for bicycle networks.
- Create a GIS data for the existing bike network to identify gaps and opportunities for improvements.

Existing Pedestrian Facilities

Installation of pedestrian facilities that include low- stress facilities and frequent use of landscape strips, medians, and frequent crosswalks are best practices. Narrow sidewalks or sidewalk gaps, crosswalks with few or no safety enhancements, and minimal number of crosswalks discourage people from walking as a means of transportation.

The community of Loleta has some narrow sidewalks or sidewalk gaps, crosswalks with few or no safety enhancements, crosswalks are minimal, and roadways are primarily arterials.

Suggestions for Potential Improvement

- Continue to identify funding sources and implement the proposed projects identified in the Bicycle and Pedestrian Master Plan.
- Create a GIS database for existing pedestrian infrastructure to identify gaps, inventory assets, and create opportunities for systemic safety analysis of all crosswalks.

Bike Network Implementation Practices

Considering the safety and comfort of people biking leads to better projects that can encourage new biking trips and enhance safety for active transportation users today and in the future. 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.

Suggestions for Potential Improvement

- Prioritize bicycle projects to align with roadway resurfacing and projects near schools.
- Secure enough funding for repaving and other complete streets projects to allow for installation of protected bike and pedestrian facilities and intersection improvements.
- Prioritize Use Level of Traffic Stress (LTS) to strategically implement bikeways and traffic calming treatments that would improve LTS of existing bikeways.

Pedestrian Network Implementation Practices

Considering the safety and comfort of people walking leads to better projects that can encourage new walking trips and enhance safety for active transportation users today and in the future.

Suggestions for Potential Improvement

- Prioritize pedestrian projects to align with roadway resurfacing and projects that are near school sites.
- Identify pedestrian priority areas and have a policy in place for crosswalk spacing and design enhancements
- Secure enough funding for repaving and other complete streets projects to allow for installation of protected bike and pedestrian facilities and intersection improvements.

Design Guidelines and Standards

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

Suggestions for Potential Improvement

Consider adopting national bicycle and pedestrian safety best practices for roadway and facility design guidelines and standards:

- NACTO Urban Street Design Guide (PDF)
- CROW Design Manual for Bicycle Traffic
- FHWA Separated Bike Lane Planning and Design Guide (PDF)
- MassDOT Separated Bike Lane Planning & Design Guide
- ITE Recommended Practice for Accommodating Pedestrians & Bicyclists
- AASHTO Guide for the Development of Bicycle Facilities (PDF)
- AASHTO Guide for the Planning, Design, ¶ Operation of Pedestrian Facilities (PDF)

Attention to Bicycle 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 crashes. 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.

In Loleta, bike treatments are not installed at intersections or through interchanges.

Suggestions for Potential Improvement

- Use green routinely to highlight conflict zones at large intersections and interchanges.
- To slow speeds at critical intersections, use smaller corner radii utilizing small design vehicles appropriate for urban areas and updated standard plans to reflect this.
- Review design of slip/trap-right lanes at intersections and implement improvements.
- Implement best practice guidance on bicycle accommodation through interchanges and expressways, as appropriate, using the ITE's Recommended Practice: Guidelines to Accommodate Bicyclist and Pedestrians at Interchanges plus consideration of protected bike lane design.
- Consider pedestrian barriers and needs when conducting bicycle barriers assessment.

Attention to Pedestrian Crossing Barriers

Similar to bicyclists crossing deterrence, crossing barriers may 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.

Loleta has no formal policy but has identified some barriers and taken steps to improve pedestrian access.

Suggestions for Potential Improvement

- To slow speeds at critical intersections, use smaller corner radii utilizing small design vehicles appropriate for urban areas and updated standard plans to reflect this.
- Review design of slip/trap-right lanes at intersections and implement improvements.
- Identify and create an inventory of pedestrian barriers with targeted recommendations for phased improvements.
- Consider pedestrian barriers and needs in conducting bicycle barriers assessment.

Intersection Control Evaluations

Providing alternative traffic controls such as roundabouts, signals, and stop signs may improve pedestrian and bicycle safety by reducing speeds and controlling vehicle conflicts. Installing bicycling signals and limiting stop signs on bicycle routes may enhance bicycle mobility and safety. The CA MUTCD defines warrants for installing signals and stop signs.

Suggestion for Potential Improvement

- Develop specific signal and stop sign warrants that are pedestrian- and bicycle-friendly.

4.5. PEDESTRIAN AND BICYCLE SUPPORT PROGRAM

The safety of vulnerable road users must be a priority, and support programs are critical for ensuring that people are able to walk and bike in their communities. Key areas to consider in this category are safe road users, safe speeds, and post-crash care.

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 drivers and people of all ages, especially school-age children where safe walking and biking habits may be instilled as lifelong lessons.

The community of Loleta has some traffic safety education programs that address pedestrians and bicycles.

Suggestion for Potential Improvement

- Conduct a formal education campaign about street safety targeting drivers, pedestrians, and bicyclists. This includes advertisements on buses and bus shelters, an in-school curriculum, community school courses, public service announcements, and a range of other strategies. Consider a focus on speed and safe driving.

Enforcement

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

In Loleta, enforcement is not data-driven or the police department does not have traffic safety officer(s).

Suggestions for Potential Improvement

- Implement sustained pedestrian safety enforcement efforts and involve the media. Use enforcement as an opportunity for education by distributing pedestrian safety pamphlets in lieu of, or in addition to, citations.
- Train officers in pedestrian safety enforcement principles.
- Establish a radar gun check-out program for trained community volunteers to record speeding vehicles' license plate numbers and send letters and/or document occurrences.

Pedestrian Walking Audit Program

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

The community of Loleta does not have a pedestrian safety program and has not conducted a walking audit.

Suggestion for Potential Improvement

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

Bicycling Safety Audit Program

Consensus is more readily reached on a vision and action plan for safety enhancements when city staff and key stakeholders ride along study corridors and experience key route and crossing challenges and best practices.

Loleta does not have a bicycling safety program and has not conducted a biking audit.

Suggestions for Potential Improvement

- Include regular bicycling audits in the citywide bicycle safety programs. Encourage interdepartmental participation.
- 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 crash rates.
- Collaborate with schools on projects beyond the school district boundaries.

Vehicle Miles Traveled (VMT) Mitigation Strategies

A VMT mitigation strategy should use the most recent guidance from California Air Pollution Control Officers Association (CAPCOA) to measure potential impacts of pedestrian and bicycle facilities.

Suggestion for Potential Improvement

- Consider utilizing the following guidebook:
  - CAPCOA Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity (PDF)

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.

In Loleta, emergency response is not involved in bicycle/pedestrian facility planning and design.

Suggestions for Potential Improvement

- Include the fire department early in the process as a stakeholder.
- 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 at reducing speed and improving bicycling access.
- Implement policies providing information on tragic incident management.

Coordination with Health Agencies

Involving non-traditional partners such as public health agencies, pediatricians and others in the planning or design of pedestrian and bicycle facilities may create opportunities to be more proactive about pedestrian and bicycle safety, identify pedestrian and bicycle safety challenges and education venues, and secure funding. Additionally, underreporting of pedestrian-vehicle and bicycle-vehicle crashes could be a problem that may be partially mitigated by involving the medical community in pedestrian and bicycle safety planning.[25]

In Loleta, health agencies are not involved in bicycle/pedestrian safety or active transportation.

Suggestion for Potential Improvement

[25] 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

- Consider coordinating with the health agencies in your community.

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.

In Loleta, bicycles are not accommodated on transit. There are few bicycle and pedestrian accommodations for accessing transit stops and stations.

Suggestion for Potential Improvement

- Work with transit agencies, Caltrans, and other relevant partners to improve access and safety to stations and bus stops.

4.6. ADDITIONAL AREAS TO CONSIDER FOR SAFETY IMPROVEMENTS

The following topics were not included in the 2024 benchmarking survey. However, they remain important strategies to consider in improving safety for people walking and biking

Surrogate Safety Measures for Proactive Monitoring

Innovative data collection techniques such as hard braking, speed, and near miss data can provide additional insights into crashes. Community feedback tools such as Street Story can assist local jurisdictions to collect data. See: Street Story: A Platform for Community Engagement

Roadway Surfaces for Bicycle Facilities

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

Suggestions 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.
- Assess the need for new and enhanced crosswalks and curb ramps with each repaving project. Include consideration of lane reductions and quick build projects such as paint and plastic median refuges and bulb outs, high-visibility crosswalks, and advanced yield markings.

Sidewalk Furniture or Other Sidewalk Zone Policies

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

Suggestion for Potential Improvement

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

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.

Suggestion for Potential Improvement

- Develop a Street Tree Ordinance to provide guidance on permissible tree types and permitting requirements, also specifying a requirement for new tree 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 guiding cyclists to facilities that have been enhanced for bicyclist use or to local retail opportunities for economic growth.

Suggestions for Potential Improvement

- Create and deploy a bicycle wayfinding strategy city/countywide as recommended in the Bicycle and Pedestrian Master Plan.
- Develop a Biking Guide that includes a bike map and bicycle locker and rack locations.

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 needs to be visible and secure and have enough capacity to accommodate bicycle demand, both long term and short term, which can be implemented through a bicycle parking ordinance.

Suggestions for Potential Improvement

- Implement short-term and long-term, secure bicycle parking at all new development, consistent with the APBP Bicycle Parking Guidelines, 2nd edition.
- Locate 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’s symbol).

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. The General Plan

identifies pedestrian priority areas, which are zones in which high volumes of pedestrian traffic are encouraged and accommodated along the sidewalk.

Suggestions for Potential Enhancement

- 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.
- Utilize vehicle miles traveled (VMT) for future transportation impact analysis.

General Plan: Safety Element

SB 99 and AB 747 involve safety evacuation during natural disasters. Local jurisdictions should identify creative solutions on how to evacuate residents safely and efficiently while maintaining and implementing low-stress pedestrian and bicycle facilities.

On safety evacuation routes, agencies should identify creative solutions for evacuating residents safely and efficiently while maintaining and implementing low-stress pedestrian and bicycle facilities.

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.

Suggestion for Potential Improvement

- Utilize vehicle miles traveled (VMT) for future transportation impact analysis.
- Consider allowing moderate to high densities in the downtown and mixed-use zones as well as 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 are weighed heavily and vehicular delay is not the primary performance measure.
- Ensure that wide sidewalks, high quality, protected bike lanes, and intersection safety improvements are included in all new development projects, particularly where densities are higher.
- Strongly weigh walking and biking performance measures as well as safety metrics in determining appropriate intersection improvements and street design.

Specific Plans, Overlay Zones, and Other Area Plans

When specific plans, overlay zones, or any other area plans are being developed, the city/county can specifically request the bicyclist and pedestrian-oriented design, walkability, or placemaking be stressed in these plans.

Suggestion for Potential Improvement

- Emphasize bicyclist and pedestrian-oriented design, walkability, and/or placemaking in all new specific plans, overlay zones, and other area plans.

Historic Sites

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

Suggestions for Potential Improvement

- Continue to implement the goals, policies and programs that support walking trips included in the Historic Preservation and Community Design Element of the General Plan to showcase natural or local sites of interest, and link key features of the city. Maps of the tour route and historic documentation materials could be made available online or as a mobile app in addition to wayfinding signs, maps, and plaques throughout the city. Consider other areas of the city for walking tours and historic signs.
- Consider upgrading History Walk signs with larger text to improve legibility and wayfinding.

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.

Suggestions for Potential Improvement

- 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 area.
- Install bicycle parking in commercial areas and provide safe, comfortable bike facilities in commercial areas to make it convenient and fun to get to local businesses.

Post-Crash Care

An agency's adopted LRSP or Caltrans-approved Safety Plan should include resources for the agency to implement identified countermeasures for medical rehabilitation, ongoing advocacy group engagement, and resources for the adjudication process to ensure offenders receive proper sentencing and treatment.

Suggestions for Potential Improvement

- Consider reviewing your agency's LRSP and add resources for implementing identified countermeasures for medical rehabilitation, ongoing advocacy group engagement, and resources for the adjudication process to ensure offenders receive proper sentencing and treatment

Proactive Approach to Institutional Coordination

Institutional coordination associated with multiple agencies and advocacy groups 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.

Suggestions for Potential Improvement

- Work with 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.

5. COMPLETE STREETS FIELD AUDIT RESULTS & SAFETY RECOMMENDATIONS

5.1. OVERVIEW

This chapter presents the observations and recommendations made during the walking audit conducted in Loleta on Friday, May 15, 2024, which included participation by agency staff and community members. The suggestions are based on best practices and discussions regarding local needs and feasibility with the participant group. A glossary of the pedestrian and bicycling improvement measures are presented in Appendix A and B, respectively.

The walking audit is conducted to understand the needs, issues, and opportunities associated with walking and biking in the study area. During the audit, positive practices are observed, and issues and opportunity areas are noted. Observations are based on how people driving behave around pedestrians and bicyclists and how people walking and biking behave, especially at intersections. Anecdotal stories shared by participants related to road users' behavior issues are also included.

The suggestions in this report are based on general knowledge of best practices in complete street design and safety, as well as discussions with participants regarding local needs and feasibility. They are intended to guide the community and the county staff in making decisions for future safety improvement projects in Loleta, but may not incorporate all factors relevant to pedestrian and bicycling safety issues in the community. This report is conceptual in nature, and conditions may exist in the focus areas that were not observed and may not be compatible with the suggestions presented below. The community and county staff may conduct further analysis to refine or discard the suggestions in this report if they are contextually inappropriate or do not improve 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 unsafe conditions.

5.2. GENERAL CITYWIDE SUGGESTIONS

The following general suggestions for physical enhancements are appropriate for countywide improvements to enhance safety for people walking and biking. These are presented in tables 5-1a and 5-1b and then discussed in further detail below.

Table 5-1a: General Safety Toolbox (Pedestrian)

Pedestrian	Details
Left-side signs on medians	At uncontrolled pedestrian crossing locations where it is feasible to add a raised median to add a secondary sign and refuge area, do this so that each approach sees a pair of warning signs on its side of the street.
Left-side warning signs: symbol orientation	Install pedestrian crossing (W11-2) or trail crossing signs (W11-15) on the left side of street to depict users approaching, similarly to how the W16-7p Downward Pointing Arrow points into the approach. (MUTCD 2A.06 Design of Signs specifically allows mirror images. However, sign catalogs may not designate a unique product code.)
Upstream sightlines	Prohibit parking for 20 feet upstream of crosswalk, to keep sightlines open to approaching traffic[26]. 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.
Advance Limit Lines	Install advance limit lines four feet in advance of controlled crosswalks to deter motorists from encroaching.
Yield Lines	Install yield lines on multi-lane approaches twenty to fifty feet before uncontrolled crosswalks.
Curb extensions	Install curb extensions to 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”) for long-distance visibility by approaching drivers.
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.
Directional curb ramps	Provide two ramps per corner, aligned with sidewalks and crosswalks, rather than diagonal ramps.
Accessibility	Ensure that signal actuation is ADA compliant.
Leading Pedestrian Interval	Display WALK phase (typically) 3 seconds before same-direction green indication, so pedestrians can occupy the curb lane.
Centerline	Install no-passing (double yellow) centerline fifty feet back from crosswalk.

[26] Starting January 1, 2025, AB 413 authorizes local jurisdictions to issue citations for parking within 20 feet of a vehicle approaching a crosswalk or 15 feet of a crosswalk when a curb extension is present.

Table 5-1b: General Safety Toolbox (Bicycle)

Bicycle	Details
Detection	Install bicycle and motorcycle detection at through, left turn, and bicycle lanes at all actuated approaches.
Right turn lanes	Where total width is insufficient for marking an adjacent bike lane, install sharrows left- aligned in the lane and add a R118(CA) “Except Bicycles” plaque to right-turn only signs.
Wayfinding	Install bicycle guide signage to destinations served by bike routes, with the name of the destination, the direction, and optionally the distance.

Advance Limit Lines

At approaches to controlled crosswalks (i.e., at signals or STOP signs), installing an advance limit line a short distance (typically four 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 hides a low pedestrian (child or wheelchair user) approaching across another lane.

Corner curb extensions

At intersections with conventional corners and no curb extensions, pedestrians preparing to cross a street typically make their crossing decisions on the sidewalk before stepping off the curb. 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) reduce crossing distance and allow pedestrians to safely make their decision near the outside travel lane, where they are more visible to approaching drivers. Raised curb extensions also enable crosswalk warning sign assemblies to be installed closer to the travel lanes where they are more visible to motorists. A resource for curb extensions is NACTO’s Urban Street Design Guide.

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 curb ramps. Costs associated with construction for improving infrastructure can be expensive. However, similar safety benefits can be obtained with less expensive options, such as “floating” islands, which do not require modifying drainage and allow pedestrians, including wheelchair users, to travel at existing street grade.

(Temporary Traffic Calming Curbs, Calgary, AB)

Figure 5-1: Segmented Floating Corner Island Treatment

Interim curb extensions

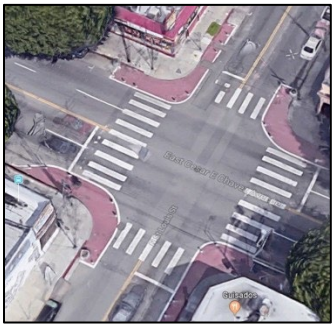
Many cities now deploy treatments consisting only of painted lines, colored paint or epoxy fill, and tubular delineators to rapidly and inexpensively create corner-bulb installations in advance of funding availability for hardscape versions. These go by various names such as “Painted Safety Zones” (San Francisco), “Painted Curb Extensions” (Pasadena), “Painted Bulbouts” (Denver) and “Interim curb bulbs” (Seattle).

The San Francisco Metropolitan Transportation Agency (SFMTA) writes:

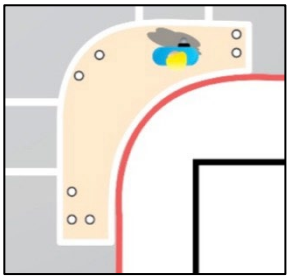
> *“Painted safety zones are painted road areas that wrap around sidewalk corners to make pedestrian crossing intersections more visible to people driving. Painted safety zones are often flanked by delineators (white posts) and encourage people who drive to slow down, especially when making turns.”*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

The Seattle Department of Transportation (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, curb bulbs may also be integrated with bioretention to manage stormwater runoff from the right-of-way.”*
>
> https://streetsillustrated.seattle.gov/urban-design/adaptive-design/intersection- treatments/



Los Angeles (Cesar Chavez & St Louis)



Pasadena Street Design Guide Los Angeles – Pico & Curson

San Francisco (16th St & Kansas St)

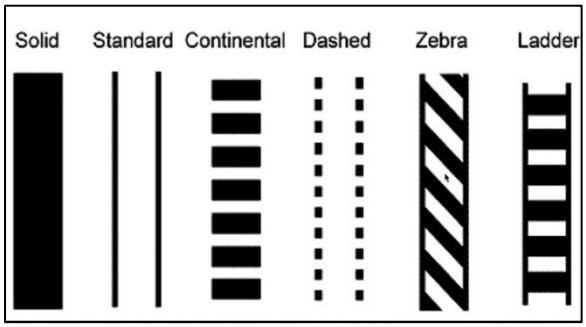
Figure 5-2: Examples of Paint and Delineator Curb Extensions

Crosswalk Marking Patterns – High Visibility and Contrast Edge

The standard crosswalk marking scheme at controlled approaches has two 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.



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

Figure 5-3: Types of Crosswalk Marking Patterns

Table 5-2: Suggested Crosswalk Treatments

Elements	Approach	Controlled		Uncontrolled	
	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, while 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. Twelve-inch transverse lines (white for non-school crosswalks, yellow for school crosswalks) may always be incorporated.

Leading Pedestrian Interval

Leading Pedestrian Interval (LPI) traffic signal phasing displays the pedestrian signal's WALK indication for three to seven seconds before the green indication for same-direction traffic. LPI gives pedestrians a head start to occupy the crosswalk before turning vehicles can enter the intersection. A 2000 study by the Insurance Institute for Highway Safety (IIHS)[27] found that LPI reduces conflicts between turning vehicles and pedestrians.

It is suggested that the county consider implementing LPI at signals with high pedestrian activity, prohibiting right-turn-on-red as needed per recent research findings. This discussion may be initiated with Caltrans for the signalized intersections along Loleta Drive.

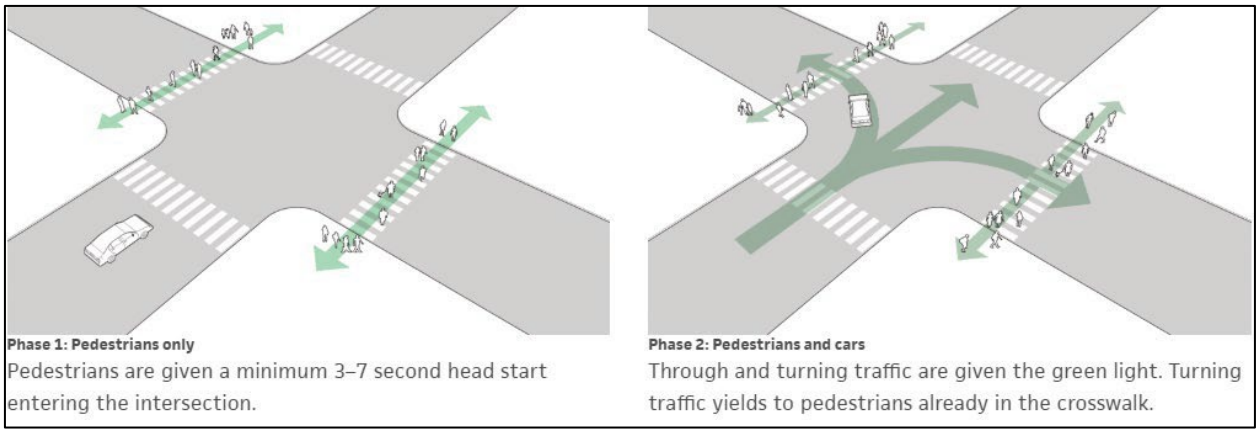


Figure 5-4: Leading Pedestrian Interval Phases

Center Islands on Side Streets

Adding pill-shaped center islands just behind the crosswalks side streets at some intersections can improve safety in a number of 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

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

Figure 5-5 shows such an island on a 40-foot residential street in Sunnyvale, California (Canary Drive, at Inverness Way). The island is 6 feet wide and 20 feet long.

Figure 5-5: Median Island on Residential Street

Bicycle guide signage

The County of Humboldt's low-stress bicycle route network can be enhanced with state-of-the-practice MUTCD-compliant bikeway network guide signage, as shown in Figure 5-6. The example shows "BIKE ROUTE" signs customized with the City of Oakland's "Oak Tree" logo in one corner. Custom (non-MUTCD) city-identity plaques can also be added atop the "BIKE ROUTE" sign, either citywide or on high-profile routes.

Decision point signs are installed in advance of a street or path intersection where travelers may want to change course to continue their current route or follow a different route.

Confirmation signs are installed after the decision-point intersection to reassure users that they made the correct choice.

Turn point signs are used as needed wherever the route curves. The destination plaques below "BIKE ROUTE" signs can display arrows and optional distances as appropriate.

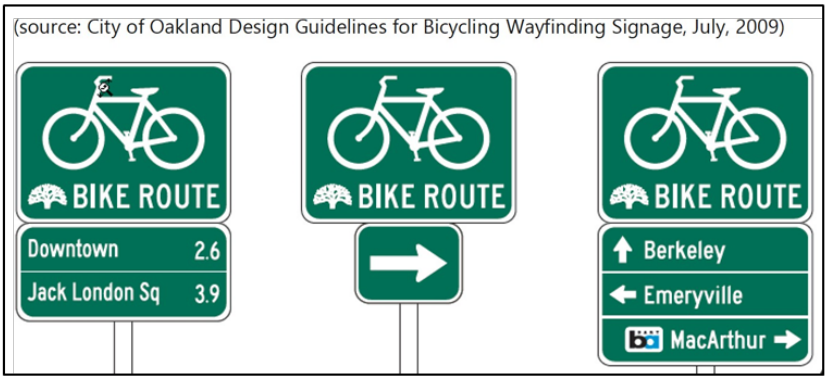


Figure 5-6: Bicycle Guide Signs

5.3. FOCUS AREA

The following sections address the focus areas of this CSSA, which includes Loleta Drive between Main Street and Shadowbrook Street. This corridor provides access to Loleta Elementary School and connects the school and downtown Loleta.

FOCUS AREA: LOLETA DRIVE BETWEEN MAIN STREET AND SHADOWBROOK STREET

Humboldt county and the community of Loleta would like to improve accessibility for people walking, biking, and rolling on Loleta Drive, and to identify safe routes to school access from downtown Loleta to Loleta Elementary School. The study focuses on providing an access route to the school that is more comfortable for pedestrians and bicycle users. This includes identifying alternative paths using other streets. Overall, the purpose of this CSAA is to identify improvements that will increase safety and mobility for all roadway users in Loleta.

Figure 5-7: Loleta Drive

Figure 5-8: Loleta Elementary School

Figure 5-9: Loleta Elementary School

The high speed of traffic on Loleta Drive, which makes it difficult for pedestrians and bicyclists to comfortably share the roadway. High truck volume on Loleta Drive further impacts pedestrian

safety. The study corridor has no controlled crosswalks, while high vehicular speeds and volume makes it difficult for pedestrians to cross the street and bicyclists to ride their bikes on the street. Loleta Drive is a two-lane roadway serving as Loleta's primary east-west collector street and providing access to US 101. The study area starts at downtown Loleta and extends to Loleta Elementary School, located at the east end of the community. The width of the street varies between 40 feet and 54 feet and has approximately 12-foot-wide lanes with parallel parking on both sides of the street near the school. In front of the school, parking is restricted to 15 minutes between 8 a.m. and 5 p.m., and is used to pick-up and drop-off students at the school. All intersections along Loleta Drive are side-street stop controlled except the intersection of Loleta Drive and Main Street, which is an all-way stop controlled. Thus, there are no protected crossings for pedestrians to cross Loleta Drive. Loleta Drive just west of the school has sharp horizontal curves, which makes it difficult for drivers to see pedestrians crossing Loleta Drive at the intersection of Loleta Drive and Shadowbrook Street right in front of the school. The speed limit for this section is posted at 25 mph.

Analysis

The Average Daily Volume (both directions) on Loleta Drive just west of Shadowbrook Street is approximately 2,620 vehicles per day (vpd), with the highest volume of 276 vehicles per hour (vph) during the p.m. peak hour. Figure 5-10 shows the distribution of trips during the day and number of vehicles per each hour of day, for trips that pass through the study corridor.

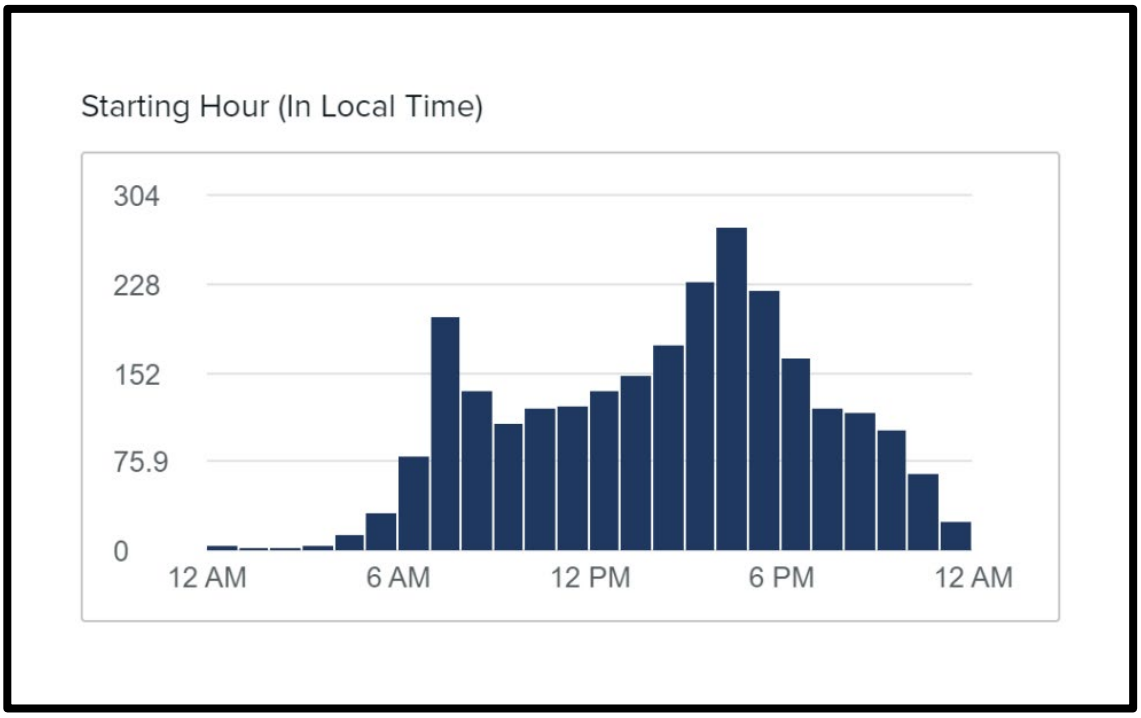


Figure 5-10: Loleta Drive Trip Start Time (Data source: Replica)

Figure 5-11 shows the number of trips by each primary mode for travel on Loleta Drive. As expected, the primary mode of travel is cars (94.6%), followed by commercial vehicle volume at 5.2%. Walking and bicycling travel volumes are very low, since people don't feel safe walking or bicycling along Loleta Drive.

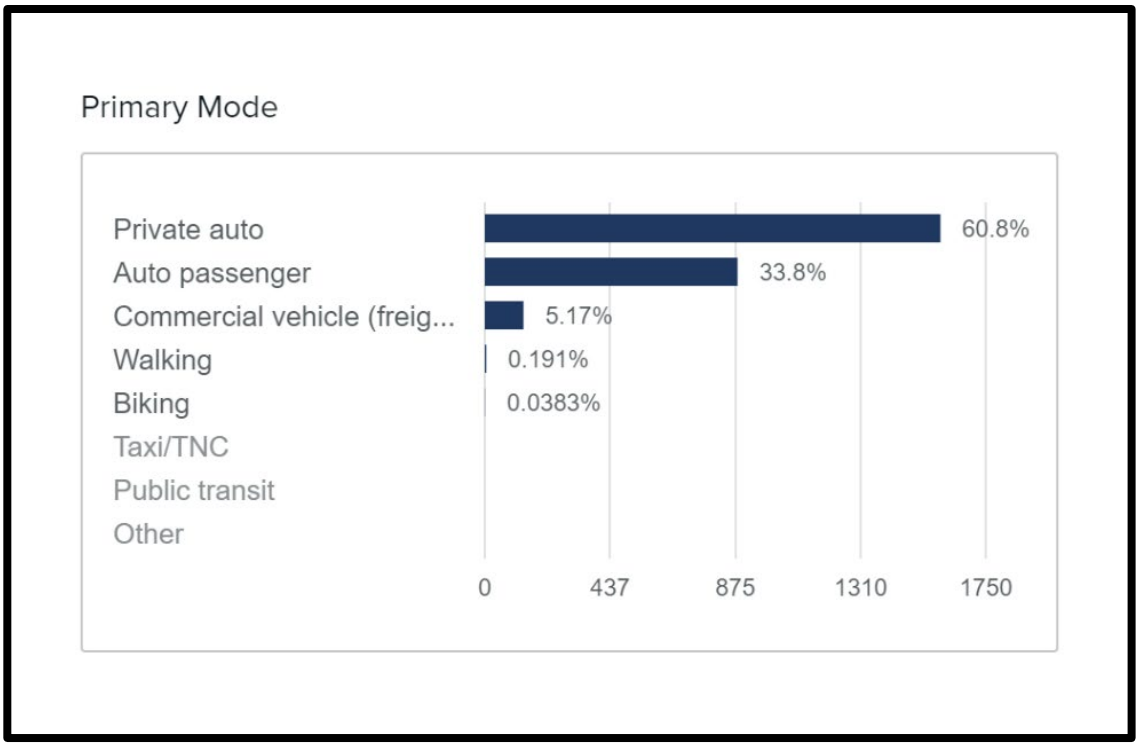


Figure 5-11: Loleta Drive Modes of Travel (Data source: Replica)

Figure 5-12 shows the number of trips by purpose for the trips that use the Loleta Drive corridor. Trip purpose is determined by the destination type of the trip. For example: if a person is traveling to work, the purpose of the trip is 'work.' If a person is traveling to a restaurant, the purpose is 'eat.' The most common type of trip was to travel home at 37.5% followed by traveling to work or school at 19.5%.

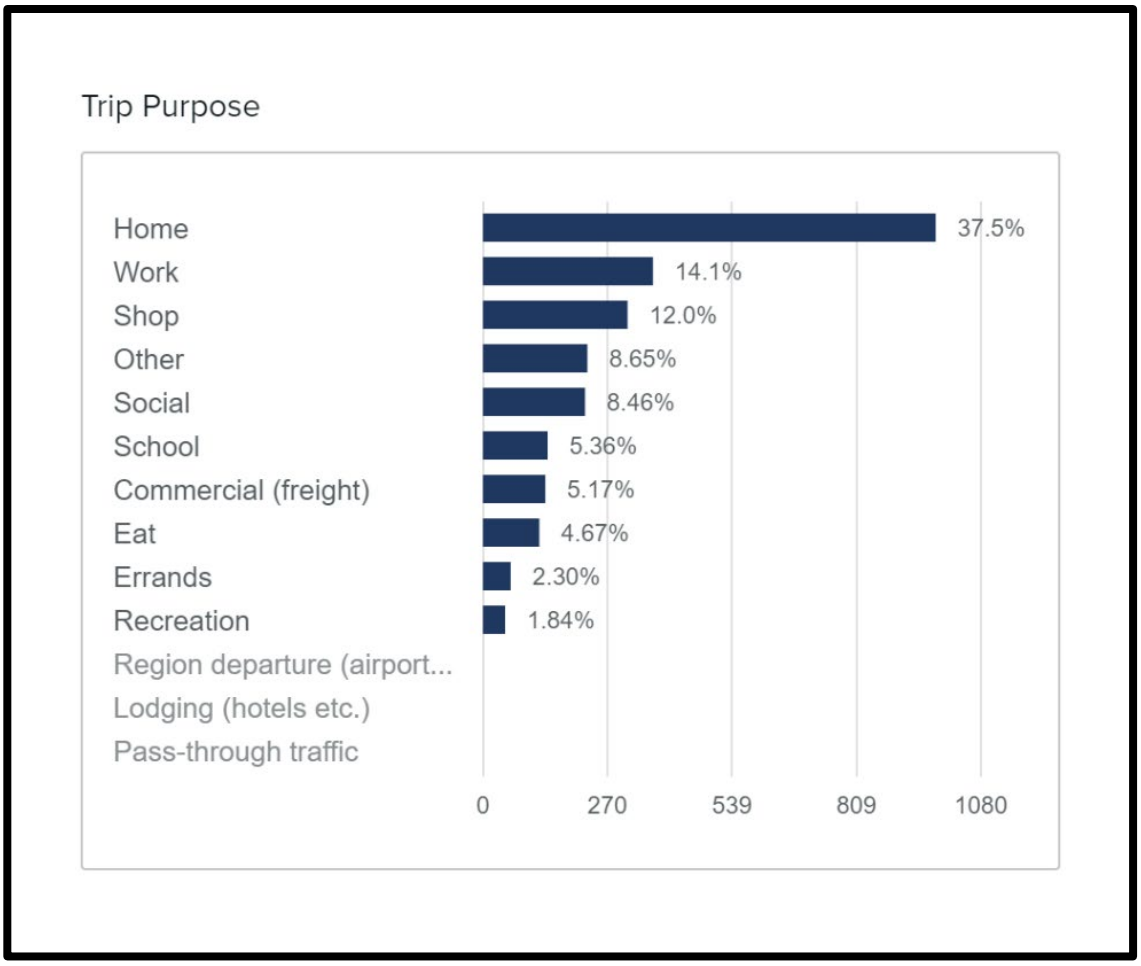


Figure 5-12: Loleta Drive Trip Purpose (Data source: Replica)

Figure 5-13 shows the length of individual trips in miles. Most trips (86.8%) are between four and sixteen miles, with an average trip length of 12.7 miles and median trip length of 8.6 miles.

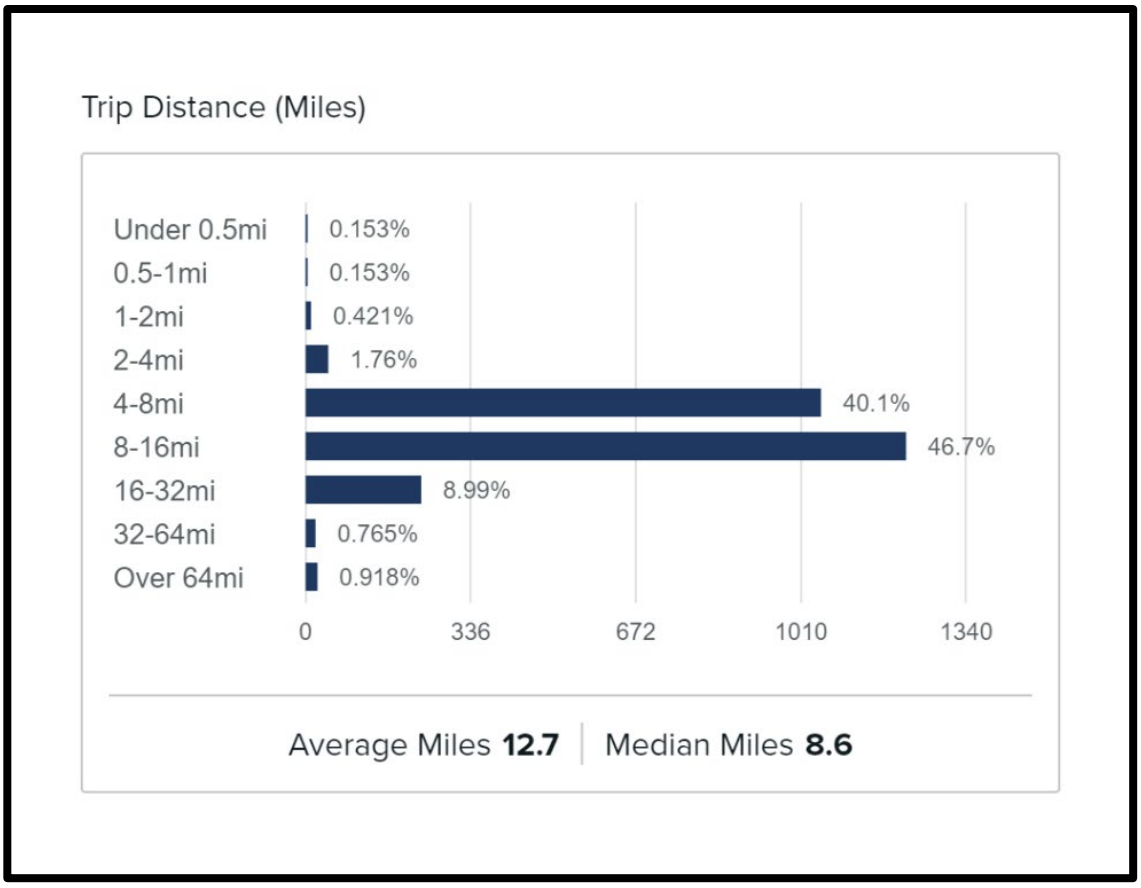


Figure 5-13: Loleta Drive Trip Distance (Data source: Replica)

Suggestions for Improvements

The following are suggestions for improvements:

Near-Term Improvements (Loleta Drive and Shadowbrook Street)

- Restripe the pedestrian crosswalks at the intersection of Loleta Drive and Shadowbrook Street to replace the worn-out crosswalk markings as shown in Figure 5-15.
- Install a Rectangular Rapid Flashing Beacon (RRFB) at the uncontrolled crosswalk across Loleta Drive at the intersection of Loleta Drive and Shadowbrook Street (see Figure 5-14). In addition to installing the RRFB, install an advanced RRFB for the eastbound direction west of the curve to provide adequate sight distance and stopping time for drivers on Loleta Drive. The advanced RRFB will light up through radio communication as soon as someone presses the push button to cross. This will warn drivers in the eastbound direction of potential upcoming pedestrian conflict. A standard crosswalk ahead sign is recommended for the westbound direction, as shown in Figure 5-16.
- Install “Yield Here to Pedestrians” signs on a pole and install yield marking on the pavement approximately 20 to 50 feet from the crosswalk near the yield markings in the eastbound direction.

- Install concrete berms around the south side of the crosswalk to create the effect of a bulb-out, shortening the conflict distance between vehicles and pedestrians crossing at the crosswalk. Install tubular markers just behind the concrete berms to prevent drivers from driving over the berm. The concrete berms will also protect the RRFB poles from being hit by vehicles. A typical example of a concrete berm and RRFB installation is shown in Figure 5-14.

Figure 5-14: Rectangular Rapid Flashing Beacon

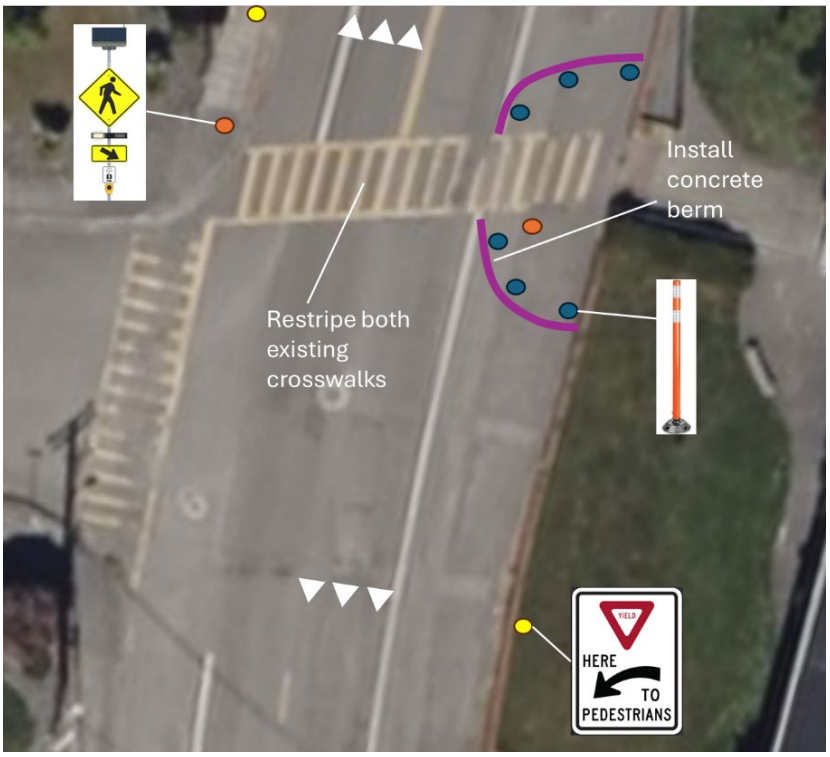


Figure 5-15: Near-Term Improvements Near the School

Figure 5-16: Installation of Advanced RRFB and Sign

Near-Term Improvements (Safe Route to School)

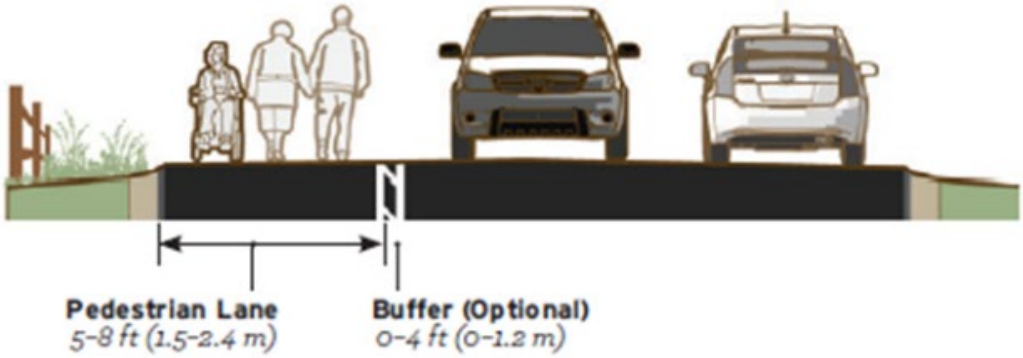
In addition to the near-term improvements suggested in front of the school, a safe route to school path is suggested to provide safer access for school students to walk to school and to provide pedestrian connectivity between downtown Loleta and the school. Loleta Drive between downtown and the school is not recommended; instead, Scenic Drive and Park Street are suggested as alternate routes as shown in Figure 5-17.

Figure 5-17: Safe Route to School

As shown in Figure 5-17, the following near-term improvements are suggested between Main Street and Shadowbrook Street to provide better pedestrian access between downtown Loleta and the school.

- Add a new sidewalk on the southside of Loleta Drive between Main Street and Railroad Avenue.
- Although the existing sidewalks along the Loleta corridor are narrow and do not meet all the American with Disabilities Act (ADA) requirements, the existing sidewalks along Loleta Drive between Railroad Avenue and Scenic Drive can be used by pedestrians. A new marked crosswalk should be installed at the east leg of the intersection of Loleta Drive and Scenic Drive to help people walking to cross Loleta Drive. Pedestrians can then use the existing sidewalks on Scenic Drive to access the existing sidewalks on Park Street to connect to the existing crosswalks at the intersection of Loleta Drive and Shadowbrook Street to access the school.
- There is no existing sidewalk on Park Street in front of the fire station. It is suggested to build a pedestrian lane with proper signage and striping to provide safe access for pedestrians to share the roadway on the northside of Park Street. Pedestrian lanes

provide temporary pedestrian accommodation on roadways lacking sidewalks. They are not intended to be an alternative to sidewalks and often fill short gaps between important destinations within the community. Pedestrian lanes are beneficial for their flexibility, cost-effectiveness, and efficient use of space, making them a good option for quick improvements or in areas with limited space. The pedestrian lane should be between five feet and eight feet wide with a buffer with flexible delineators. The pedestrian lane will restrict parking in from front of the fire station to Loleta Drive. Proper signage should be provided to restrict parking where the pedestrian lane is being proposed. A typical pedestrian lane design is shown in Figure 5-20. Figure 5-21 shows an example of a pedestrian lane implemented at other locations.



(From the Small Town and Rural Design Guide
https://ruraldesignguide.com/visually-separated/pedestrian-lane)

Figure 5-18: Pedestrian Lane Schematic

Figure 5-19: Pedestrian Lane Signage

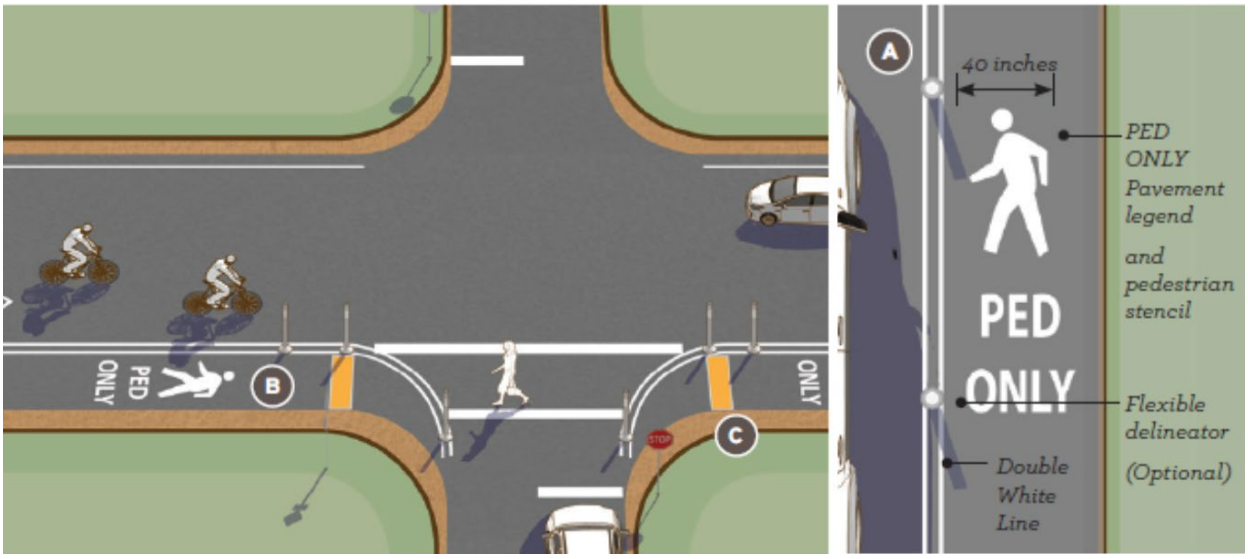


Figure 5-20: Pedestrian Lane Design

Figure 5-21: Example of a Pedestrian Lane

<u>Long-Term Improvements (Safe Routes to School)</u>

The following longer-term improvements are suggested:

- Widen sidewalks to 10 feet and provide ADA ramps at all crosswalks along Loleta Drive, Scenic Drive, and Park Street, as shown in Figure 5-22.
- In addition to widening sidewalks, install a RRFB at the intersection of Loleta Drive and Scenic Drive for the proposed crosswalk on the east side of the intersection, to improve

pedestrian visibility and allow safe crossing for pedestrians crossing Loleta Drive to continue to Scenic Drive.

- Build new sidewalks in front of the fire station on the north side of Park Street. This would provide a continuous sidewalk along the north side of Park Street to Loleta Drive.
- Widen the sidewalk on the north side of Loleta Drive east of Park Street and provide a retroreflective yellow crosswalk at the intersection of Loleta Drive and Park Street on the north side of the intersection, as shown in Figure 5-23.

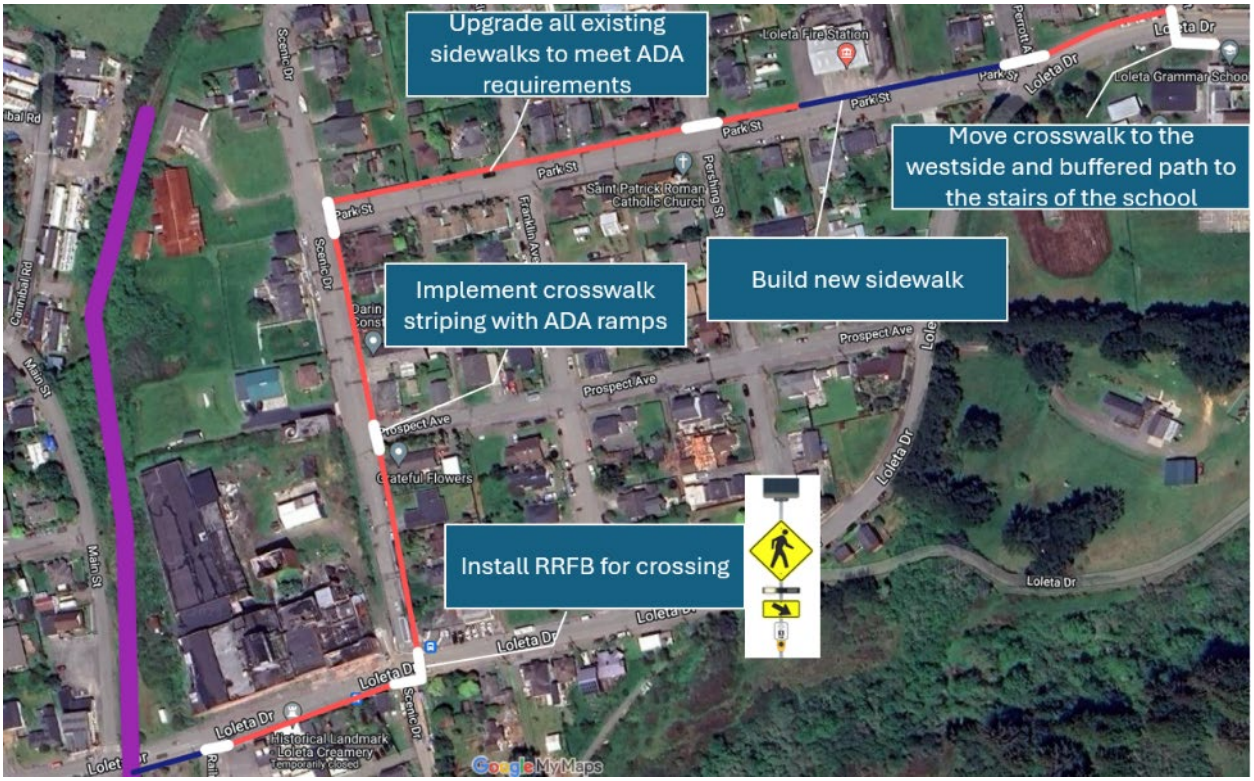


Figure 5-22: Long-Term Safe Route to School

Figure 5-23: Crosswalk at the Intersection of Loleta Drive and Park Street

Long-Term Improvements (Loleta Drive and Shadowbrook Street)

- Move the crosswalk from the east side of the intersection of Loleta Drive and Shadowbrook Street to the west side of the intersection. Moving the crosswalk would improve sight distance around the roadway curvature on Loleta Drive.
- Upgrade the ramp on the northwest corner to meet ADA requirements to serve both the crosswalks on the west and the north side of the intersection.
- Install RRFB at the new crosswalk for Loleta Drive along with an advanced RRFB for the eastbound direction. Install Yield markings on the roadway pavements and install proper signage for the intersection.
- Install concrete berms and tubular markers on the south side of the intersection to provide separated access for students from the proposed crosswalk to the school stairway. The proposed improvement for the intersection is shown in Figure 5-24.

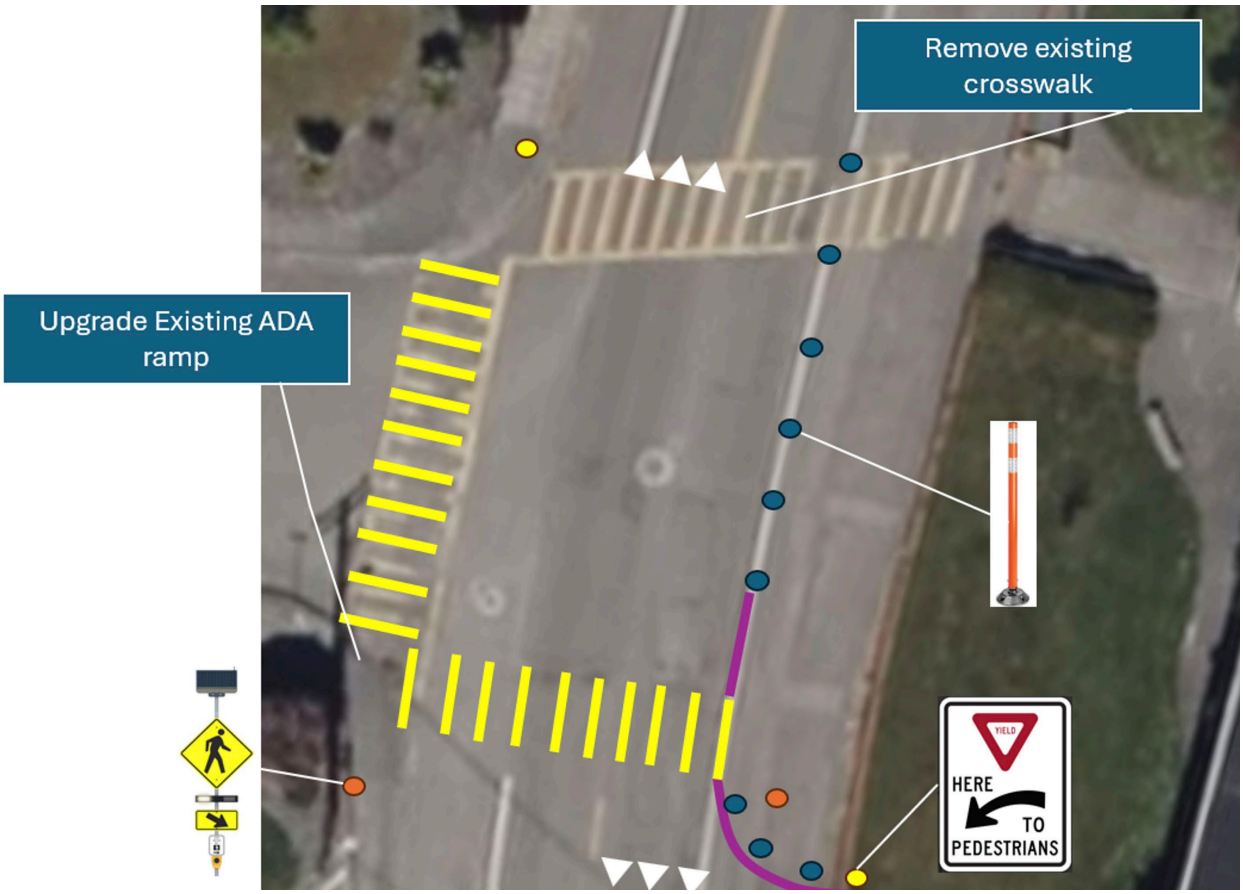


Figure 5-24: Long-Term Safe Route to School

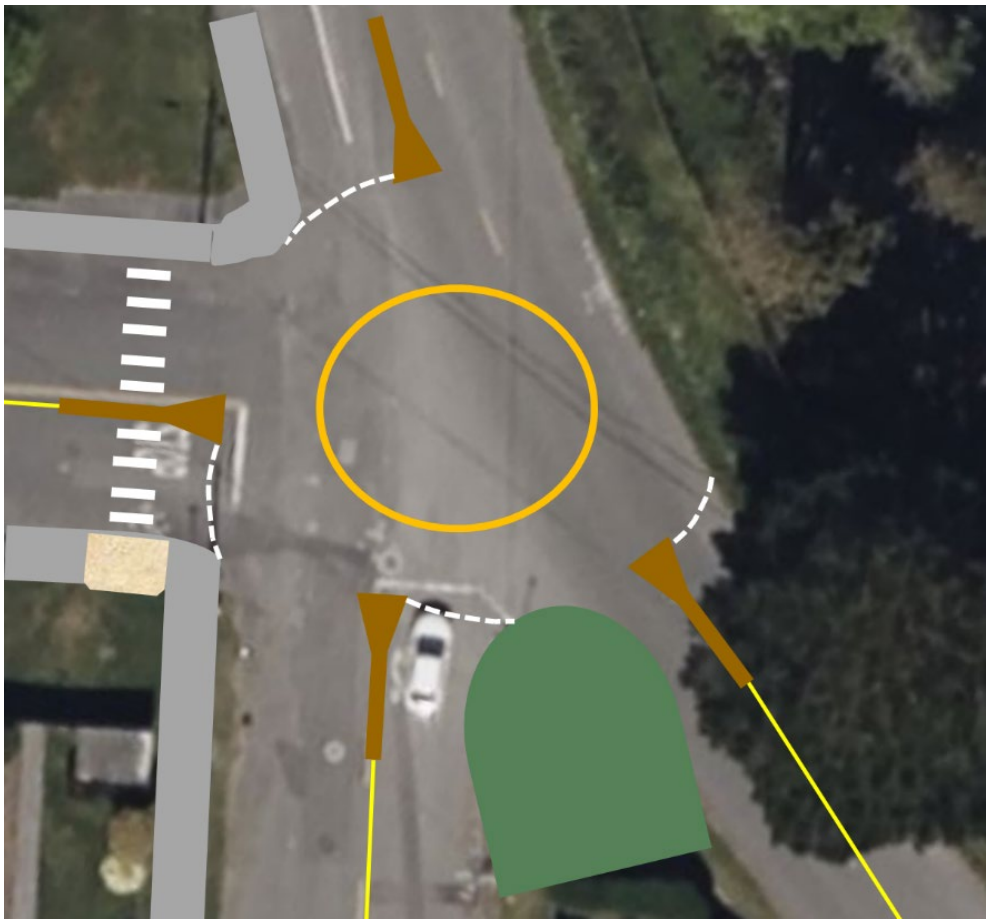


Figure 5-25: Concept Plan - Roundabout

Long-Term Improvements (Loleta Drive / Park Street / Perrott Avenue)

Consider installing a roundabout at the intersection of Loleta Drive / Park Street / Perrott Avenue. Roundabouts offer numerous advantages, including enhanced safety, improved traffic flow, environmental benefits, cost-effectiveness, and potential aesthetic enhancements. These benefits make roundabouts a compelling alternative to traditional intersections in many settings, especially at intersections with more than four approaches, as is the case at the intersection of Loleta Drive/Park Street/Perrott Avenue. Roundabouts also lower drivers' speeds along a corridor, and residents shared that people drive well over the speed limits on Loleta Drive. At a roundabout, drivers must slow down to navigate through. Roundabouts also have fewer conflict points that are right-angles or head-on, thereby reducing the severity of any crashes that may occur at intersections. Figure 5-25 illustrates a concept plan for a roundabout at this intersection. However, prior to implementation of a roundabout a detailed Intersection Control Evaluation (ICE) study is recommended and required by Caltrans.

ABOUT THE PROGRAM

The Complete Streets Safety Assessment (CSSA) conducts comprehensive transportation safety assessments that focus on pedestrian and bicycle safety. The aim of the CSSA is to help communities identify and implement traffic safety solutions that lead to improved safety and accessibility for all users, especially people walking and biking, on California's roadways.

The Safe Transportation Research and Education Center (SafeTREC) is a University of California, Berkeley research center affiliated with the Institute of Transportation Studies and the School of Public Health. Our mission is to inform decision-making and empower communities to improve roadway safety for all. We envision a world with zero roadway fatalities or serious injuries and a culture that prioritizes safe mobility.

For more information, visit: https://safetrec.berkeley.edu or email us at safetrec@berkeley.edu.

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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 (Crash history).
Pedestrian Hybrid Beacon	PHBs (Pedestrian Hybrid Beacons) are pedestrian-actuated signals that are a combination of a beacon flasher and a traffic control signal. When actuated, PHBs display 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.

PEDESTRIAN IMPROVEMENT MEASURES

Measure	Description	Benefits	Application
Rectangular Rapid Flashing Beacon	A Rectangular Rapid Flashing Beacon (RRFB) is a pedestrian-actuated enhancement that improves safety at uncontrolled, marked crossings.	FHWA states that research indicates RRFBs can result in motorist yielding rates as high as 98 percent at marked crosswalks. Solar panels reduce energy costs associated with maintenance of the device.	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 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.

PEDESTRIAN IMPROVEMENT MEASURES

Measure	Description	Benefits	Application
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.
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 Crash 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.

PEDESTRIAN IMPROVEMENT MEASURES

Measure	Description	Benefits	Application
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.
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.	Suggested 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.

PEDESTRIAN IMPROVEMENT MEASURES

Measure	Description	Benefits	Application
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.
Curb Ramps	Curb ramps are sloped ramps that are constructed at the edge of a curb (normally at intersections) and are bi-directional (if applicable), 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.

PEDESTRIAN IMPROVEMENT MEASURES

Measure	Description	Benefits	Application
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.
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 Crashes, 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.

PEDESTRIAN IMPROVEMENT MEASURES

Measure	Description	Benefits	Application
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.
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 Crash 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.	All pedestrian signals should incorporate countdown signals. 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			

PEDESTRIAN IMPROVEMENT MEASURES

Measure	Description	Benefits	Application
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.
Enhanced Bus Stop Amenities	Adequate bus stop signing, lighting, a bus shelter with seating, trash receptacles, and bicycle parking are desirable features at bus stops.	Increase pedestrian visibility at bus stops and encourage transit ridership.	Appropriate at sites with high patron volumes.

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			

BICYCLING IMPROVEMENT MEASURES

Measure	Description	Benefits	Application
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 Crashes 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 Crash 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.
Left-Turn Staging Box	This roadway treatment provides bicyclists with a means of safely making a left turn at a multi-lane signalized intersections from a bike lane or cycle track on the far-right side of the roadway.	Bicyclists are protected from the flow of traffic while waiting to turn.	Appropriate for multilane roadways. Can also be mirrored for right-turns from a one-way street with a left-side bikeway.

BICYCLING IMPROVEMENT MEASURES

Measure	Description	Benefits	Application
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 suggested 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.

BICYCLING IMPROVEMENT MEASURES

Measure	Description	Benefits	Application
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 complements 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			
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 which typically is 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).

BICYCLING IMPROVEMENT MEASURES

Measure	Description	Benefits	Application
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 Crash 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.

BICYCLING IMPROVEMENT MEASURES

Measure	Description	Benefits	Application
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 Crash, 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 which is designates 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 how much time they have to left to cross the intersection.	The 2012 MUTCD requires all pedestrian signals to incorporated countdown signals within ten years
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.

BICYCLING IMPROVEMENT MEASURES

Measure	Description	Benefits	Application
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.
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 to	Must meet warrants based on traffic/ pedestrian / bicycle volumes, Crash 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.

BICYCLING IMPROVEMENT MEASURES

Measure	Description	Benefits	Application
Pedestrian Hybrid Beacon	PHBs (Pedestrian Hybrid Beacon) are pedestrian-actuated signals that are a combination of a beacon flasher and a traffic control signal. When actuated, PHBs display 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.
Rectangular Rapid Flashing Beacon	A Rectangular Rapid Flashing Beacon (RRFB) is a pedestrian-actuated enhancement that improves safety at uncontrolled, marked crossings.	FHWA states that research indicates RRFBs can result in motorist yielding rates as high as 98 percent at marking crosswalks. Solar panels reduce energy costs associated with maintenance of the device.	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)

BICYCLING IMPROVEMENT MEASURES

Measure	Description	Benefits	Application
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 Crash 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
A Guide for Reducing Collisions Involving Pedestrians (NCHRP Report 500) http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_500v10.pdf
Pedestrian and Bicycle Information Center http://www.walkinginfo.org/
National Center for Safe Routes to School http://www.saferoutesinfo.org/
Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations (HRT-04-100) http://www.thrc.gov/safety/pubs/04100/index.htm
How to Develop a Pedestrian Safety Action Plan (FHWA-SA-05-12) http://www.walkinginfo.org/pp/howtoguide2006.pdf
Improving Pedestrian Safety at Unsignalized Crossings (NCHRP Report 562) http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_562.pdf
Road Safety Audits: Case Studies (FHWA-SA-06-17) http://safety.fhwa.dot.gov/rsa/rsa_cstudies.htm
Pedestrian Road Safety Audit Guidelines and Prompt Lists http://drusilla.hsrc.unc.edu/cms/downloads/PedRSA.reduced.pdf
PEDSAFE: The Pedestrian Safety Guide and Countermeasure Selection System (FHWA-SA-04-003) http://www.walkinginfo.org/pedsafe/
Pedestrian and Bicycle Crash Analysis Tool (PBCAT) http://www.bicyclinginfo.org/bc/pbcat.cfm
FHWA, A Resident's Guide for Creating Safe and Walkable Communities http://safety.fhwa.dot.gov/ped_bicycle/ped/ped_walkguide/index.htm
FHWA, Pedestrian Safety Guide for Transit Agencies (FHWA-SA-07-017) http://safety.fhwa.dot.gov/ped_bicycle/ped/ped_transguide/
FHWA Pedestrian Safety Training Courses:
Developing a pedestrian safety action plan (two-day course) *next California course:* http://www.google.com/calendar/embed?src=lssandt@email.unc.edu
Designing for pedestrian safety (two-day course) *next California course:* http://www.google.com/calendar/embed?src=lssandt@email.unc.edu
Planning and designing for pedestrian safety (three-day course) *next California course:* http://www.google.com/calendar/embed?src=lssandt@email.unc.edu
Adapted from FHWA Pedestrian Road Safety Audit Guidelines and Prompt Lists

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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
From the CROW English website, http://www.crow.nl/English
CROW is The Netherlands technology platform for transport, infrastructure and public space. It is a not-for-profit organization in which the government and businesses work together in pursuit of their common interests through the design, construction and management of roads and other traffic and transport facilities. Active in research and in issuing regulations, CROW focuses on distributing knowledge products to all target groups.

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 suggests that pedestrian (and bicycle) path connections to be every 300 to 500 feet; for motor vehicles, they suggest 500 to 1,000 feet.[1] [2] 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.[3]

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

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[1] 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).

[2] American Association of State Highway and Transportation Officials (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).

[3] 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.

Berkeley Safe Transportation Research and Education Center

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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.

Our Mission

SafeTREC's mission is to inform decision-making and empower communities to improve roadway safety for all.

Our Vision

We envision a world with zero roadway fatalities or serious injuries and a culture that prioritizes safe mobility.

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