



CITY OF MANHATTAN BEACH

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STAFF REPORT

Agenda Date: 3/26/2026

TO:

Honorable Parking and Public Improvements Commission Chair and Commissioners

THROUGH:

Masa Alkire, AICP, Community Development Director

FROM:

Erik Zandvliet, T.E., City Traffic Engineer

SUBJECT:

Consideration of Traffic, Bicycle and Pedestrian Safety Measures along Sepulveda Boulevard
DISCUSS AND PROVIDE DIRECTION

RECOMMENDATION:

Staff recommends that the Commission pass a motion to recommend that the City Council consider a list of potential safety measures on Sepulveda Boulevard to be implemented or studied further for future consideration.

BACKGROUND:

On May 20, 2025, the City Council directed staff to provide a comprehensive report on potential safety measures on Sepulveda Boulevard (State Route 1) in response to three fatal crashes on December 16, 2024, January 8, 2025, and May 4, 2025, along this corridor, two of which were pedestrian fatalities. The City also reached out to Caltrans immediately following the second collision to initiate a joint effort to conduct a safety investigation.

Since June 2025, the City has been collaboratively working with Caltrans District 7 Division of Transportation Safety & Operations to evaluate and implement long-term safety solutions. City and Caltrans staff from multiple departments have been holding tri-weekly meetings to expedite a comprehensive safety evaluation along the Sepulveda Boulevard corridor. This staff task force has identified more than 40 potential safety countermeasures that are described later in this report.

In addition, the Manhattan Beach Police Department has significantly expanded its safety and enforcement efforts, including the following actions:

- Conducted a DUI checkpoint in July, with another planned next month;
- Conducted increased educational outreach with message boards and social media;
- Increased police presence on Sepulveda Boulevard with high-visibility enforcement and DUI patrols; and
- Deployed surveillance cameras to monitor traffic and pedestrian behavior.

This staff report summarizes the actions that have already been taken, describes the safety study methodology and process, and proposes numerous safety countermeasures that could be

implemented by the City and Caltrans that would reduce the risk of fatal and injury crashes along Sepulveda Boulevard in the future. The Parking and Public Improvements Commission (Commission) should review and discuss these potential traffic safety measures and recommend that the City Council further pursue those measures that it believes warrant further evaluation.

DISCUSSION:

Study Methodology

At the City Council direction, staff has conducted an extensive safety analysis of the Sepulveda Boulevard corridor. This safety analysis follows the Safe System Approach (SSA), which is a federally adopted multi-faceted strategy aimed at reducing fatalities and serious injuries on public roads. The SSA identifies six interconnected elements to achieve the goal of zero traffic fatalities and serious injuries on all of California's public roadways: Safe Road Users, Safe Vehicles, Safe Speeds, Safe Roads, Post-Crash Care and Safer Land Use. The SSA is designed to accommodate human mistakes and injury tolerances, ensuring that all road users can travel safely. It is part of the California Strategic Highway Safety Plan (SHSP), which is a federally required plan that guides resource and investment decisions to achieve zero traffic fatalities and serious injuries. The SHSP utilizes a data-driven process to identify key safety needs and guides resource and investment decisions that provide the greatest potential to achieve the plan's goal of zero traffic fatalities and serious injuries on all of California's public roadways.

A number of local, state and federal road safety resources were reviewed to determine potential safety measures that may be appropriate based on the location, circumstances and primary collision factors of recent injury and fatal collisions along the study segment. The resources are listed below with additional information attached to this report:

- Making our Roads Safer-28 Proven Safety Countermeasures (FHWA)
- Safe Systems Approach (FHWA)
- Crash Modification Factor Clearinghouse Guide
- Countermeasures That Work (NHSTA)
- AASHTO Highway Safety Manual
- Implementing the Safe Systems Approach (CalBerkley SafeTREC)
- Traffic Calming Guide (Caltrans)
- Caltrans Highway Design Manual
- City of Manhattan Beach Neighborhood Traffic Calming Program
- City of Manhattan Beach Mobility Element

Existing Conditions

Sepulveda Boulevard (State Route 1) within the City limits is a six-lane conventional State highway in a retail and commercial zone with raised median islands separating the northbound and southbound lanes. There is also a residential overlay district on both sides of Sepulveda Boulevard that allows high density residential projects on properties that are zoned "General Commercial". The Manhattan Village Shopping Center is located on the east side of Sepulveda between Marine Avenue and Rosecrans Avenue. The Skechers headquarters occupies several large buildings on both sides of Sepulveda Boulevard between Tennyson Street and Ronda Drive. Residential homes are located in neighborhoods directly behind the commercial and retail properties fronting Sepulveda Boulevard.

There are ten signalized intersections and 20 unsignalized intersections within the City limits, with exclusive left turn lanes (left turn pockets) at all intersections. Private driveways are located on both sides of the street at closely spaced intervals. Sepulveda Boulevard has an average daily traffic volume of 41,500 vehicles per day between Artesia Boulevard and Manhattan Beach Boulevard, and

41,500 vehicles per day between Manhattan Beach Boulevard and Rosecrans Avenue. Parking is allowed in the curb lane in each direction during certain hours between Artesia Boulevard and 33rd Street adjacent to commercial properties. Sidewalks are generally less than 10 feet wide and some areas have high pedestrian volumes. Roadway lighting is provided along most of the street length.

Engineering and Traffic Survey

In 2023, Caltrans conducted an Engineering and Traffic Survey on this segment of Sepulveda Boulevard. California Vehicle Code Sections 40801 and 40802 require Engineering and Traffic Surveys (ETS) to establish or revise prima facie speed limits on certain streets within a local jurisdiction before law enforcement can utilize radar or other electronic speed measuring devices for speed enforcement. These surveys must be updated every five, seven, or ten years to ensure the speeds reflect current conditions as dictated by the California Vehicle Code.

A key element in the Survey is the identification of the 85th percentile speed. The 85th percentile speed, also known as the critical speed, is the speed at or below which 85 percent of the traffic travels. This threshold represents what is historically found to be a safe and reasonable speed for most drivers based on normal roadway conditions. The 10-mile an hour (MPH) pace speed is the 10-mile range with the highest concentration of speed samples, meaning that most drivers are driving within this 10-mile speed range. The speed study conducted for the Survey found the following critical and 10-MPH pace speeds:

SEGMENT	85TH %TILE SPEED		10 MPH PACE	
	NB	SB	NB	SB
Artesia Blvd. to Longfellow Ave.	37	34	28-37	26-35
Longfellow Ave. to 2nd St.	31	39	22-31	30-39
2nd St. to 8th St	37	34	26-35	25-34
8th St. to Manhattan Beach Blvd.	41	39	32-41	30-39
Manhattan Beach Blvd. to Marine Ave.	39	40	27-36	31-40
Marine Ave. to Rosecrans Ave.	39	38	26-35	29-38

Source: State of California 2023 Engineering and Traffic Survey

The Survey also evaluated the crash history during a three-year period between October 1, 2019 and September 30, 2022, and found the following crash rates:

Crash Rate:

Date Range:	3 Years (10/02/2019 - 9/30/2022)
Artesia Bl. to 22nd Street	0.73 crashes/Million Vehicle Miles
22nd St. to Rosecrans Avenue	0.48 crashes/Million Vehicle Miles
Statewide Average Crash Rate:	0.97 crashes/Million Vehicle Miles

The Caltrans Engineering and Traffic Survey determined that the appropriate posted speed limit pursuant to State guidelines is 35 miles per hour (MPH) in both directions. The approved Survey is attached to this report.

Crash History Analysis

An extensive review of the crash history was conducted for Sepulveda Boulevard between Artesia Boulevard and Rosecrans Avenue. Crash data was obtained from the State of California’s Traffic Incident Management System (TIMS) database. For this study, crash data from the latest 4.75 years of reported crashes between January 1, 2021 and September 30, 2025 was used. Crash rates for

each street segment are expressed in crashes per million vehicle miles (MVM). The segment’s actual collision rate was then compared to the average statewide collision rate for that particular roadway type, as obtained from the “Collision Data on California State Highways” report published by Caltrans in 2023. It should be noted that property damage only crash data is not recorded in the State’s database.

The crash history review reveals that there were three fatal crashes in this 4.5 year period, as summarized below:

- Fatal collision on December 16, 2024, (6:28AM) involving with a northbound driver on Sepulveda Blvd colliding with an eastbound pedestrian outside the crosswalk at 8th St. .
- Fatal collision on January 8, 2025, (11:25PM) involving a speeding southbound driver on Sepulveda Boulevard colliding with a westbound driver at 5th Street making a left turn.
- Fatal collision on May 4, 2025, (12:45AM) involving a northbound driver on Sepulveda Boulevard colliding with a westbound pedestrian at Ronda Drive.

The following table identifies the number of fatal and injury crashes by street segment and year, with 4.75 year averages as well as a comparison of actual versus statewide crash rates:

SEGMENT	FATAL AND INJURY CRASHES					Ave.
	2021	2022	2023	2024	2025*	
Artesia Blvd. to Longfellow Ave.	3	3	3	2	0	2.31
Longfellow Ave. to 2nd St.	0	2	0	0	3	0.63
2nd St. to 8th St	1	1	1	2	2	1.47
8th St. to Manhattan Beach Blvd.	2	2	2	1	1	1.68
Manhattan Beach Blvd. to Marine Ave.	4	1	6	3	6	4.21
Marine Ave. to Rosecrans Ave.	3	4	6	3	2	3.79
TOTAL	13	13	18	11	14	14.53
Fatal	0	0	0	1	2	0.63
# Injured	24	18	28	12	19	21.26
Pedestrian	1	1	3	2	3	2.10
Bicycle	2	1	1	0	2	1.26
Motorcycle	0	0	3	2	2	1.47
Fatal/Injury Crashes per MVM	0.36	0.36	0.50	0.30	0.39	0.41
Statewide Ave. F/I Crashes/MVM	0.50	0.50	0.50	0.50	0.50	0.50
Fatal Crashes per MVM	0	0	0	0.28	0.56	0.084
Statewide Avg. Fatal Crashes/MVM	0.013	0.013	0.013	0.013	0.013	0.013

MVM = Million Vehicle Miles

* - Incomplete (1-9/2025)

This 4.75 year analysis found the following crash types breakdown:

Fatal and Injury Crash Type:

- Automobile Only - 66.9%
- Pedestrian Involved - 14.4%
- Bicycle Involved - 8.6%
- Motorcycle Involved - 10.1%

A map of Fatal and Injury collisions within the study period is attached to this report.

Potential Safety Countermeasures

The FHWA has identified and is promoting widespread use of a set of 28 Proven Safety Countermeasures that can offer significant, measurable impacts as part of any agency's data-driven, systemic approach to improving safety. These strategies are designed to enhance safety on all kinds of roads. Each countermeasure addresses speed management, intersections, roadway departures, or pedestrians/ bicyclists- along with crosscutting strategies that address all four safety focus areas. A detailed description of countermeasures is attached to this report.

This safety study analyzed potential countermeasures using the FHWA Crash Modification Factors (CMF) Clearinghouse Guide. The CMF Clearinghouse is a comprehensive and searchable database of published CMFs. It contains all CMFs from a variety of research documents, including the AASHTO Highway Safety Manual and the FHWA Desktop Reference for Crash Reduction Factors.

This safety evaluation also reviewed the City's Neighborhood Traffic Management Program for potential safety measures that could address the primary collision factors for the crashes along Sepulveda Boulevard, particularly injury and fatal crashes.

The potential safety measures specifically identified for Sepulveda Boulevard generally fall into the following countermeasure categories and sub-categories:

- Access management (to reduce points of conflict between vehicles)
 - Construct median barriers to prohibit high-conflict turning movements
- Advanced technology and ITS (for driver education and crash prevention)
 - Install speed feedback signs
 - Install traffic monitoring sensors
- Bicyclists (to improve safety for vulnerable road users)
 - Install bicycle lanes, sharrows and bike detection on specific cross-streets
- Delineation (to channelize and separate traffic flow)
 - Install Keep Clear, speed and yield pavement markings
 - Add lane extension lines through intersection
 - Restripe with high-reflectivity striping after resurfacing
- Intersection geometry (for positive guidance through intersections)
 - Add dual left turn lanes at Manhattan Beach Blvd.
 - Construct channelizing islands to prohibit illegal turns
- Intersection traffic control (to improve pedestrian safety and reduce points of conflict)
 - Install leading pedestrian signal timing at all traffic signals
 - Add vehicle detection at signalized intersections
 - Prohibit left turns at some unsignalized intersections
 - Install right turn only restrictions on some high-conflict side streets
- Pedestrians (to improve pedestrian safety, give positive guidance and driver awareness)
 - Install high-visibility crosswalks
 - Construct sidewalks, remove barriers
 - Construct directional access ramps
 - Construct ADA compliant ramps
 - Install pedestrian crossing prohibition signs
- Pavement condition and friction (to improve braking performance and driver visibility)
 - Resurface roadway for all-weather, high contrast striping
- Shoulder treatments (for positive lane control)

- Reduce shoulder width restriping
- Signs (to educate drivers and reduce unsafe pedestrian activity)
 - Install pedestrian crossing prohibition signs
 - Install speed limit signs
- Speed Management
 - Install speed feedback signs
 - Conduct targeted speed enforcement
 - Conduct DUI and vehicle safety checkpoints

During the last nine months, the Caltrans and City staff task force have evaluated a wide range of safety countermeasures and analyzed their potential to reduce the crash risk of pedestrian, bicyclist and motorists along Sepulveda Boulevard in the City. Based on the history of crash types and locations, specific locations were then identified for potential countermeasures. The countermeasures with the greatest potential to reduce future crash rates were then plotted on a street plan and summarized in a table, both of which are attached to this Report.

As noted on the potential safety measures list and plan, many of the measures have already been initiated or are included in a current project. For example, a Caltrans street resurfacing project currently under construction includes or has been modified to include many safety measures, such as ADA curb ramps, high visibility crosswalks, pedestrian crossing treatments and signs, vehicle detection at traffic signals, leading pedestrian walk signals, and a variety of other striping changes. Similarly, the City has two neighborhood traffic management plans (in the Gelsons Market Area and in the Sketchers Area) in progress that will be used to present potential traffic circulation changes and bike facilities to the adjacent neighborhoods for their consideration. The City has also purchased two new electronic speed feedback signs to be installed on Sepulveda Boulevard.

Other Safety Corridors in California

On October 15, 2025, the California State Transportation Agency (CalSTA) launched a new State Priority Safety Corridor initiative aimed at preventing fatal and serious injuries on the state's roadways. These corridors apply the Safe System Approach, now formally adopted through the Joint Secretary's Policy on Road Safety, into action at the corridor scale. CalSTA has identified two priority corridors to date: Avalon Boulevard in Los Angeles and Varner Road in Thousand Oaks, as pilot projects. Each corridor is prioritized and supported by data as a high-injury location where State, regional, and local partners will apply the Safe System principles of prevention, shared responsibility, and equity to reduce harm and save lives.

The "Go Safely PCH" campaign is Malibu's major safety initiative aimed at slowing drivers down, increasing enforcement, and reducing the severe crashes on a 21-mile section of Pacific Coast Highway. It was launched after a series of deadly incidents, including the 2023 crash that killed four Pepperdine students, and combines public education, infrastructure upgrades, and stepped-up law enforcement to protect residents, visitors, cyclists, and pedestrians. The campaign included State legislation to authorize the installation of five speed camera systems along the segment, a long term agreement with the California Highway Patrol for speed enforcement, public safety awareness campaign, DUI checkpoints, and \$4.3 million in road, bicycle and pedestrian infrastructure safety improvements.

CONCLUSION:

The goal of this report has been to conduct a data-driven safety evaluation of the Sepulveda Boulevard corridor, introduce a variety of relevant safety countermeasures, and propose locations where they could be implemented for the Commission's consideration. Further analysis and public outreach will be necessary before any potential safety measures that might impact access to neighborhood or commercial properties are implemented. It is recommended that the Commission discuss the

potential traffic safety measures, hear public testimony and pass a motion to recommend a list of potential measures that should be implemented or studied further for future consideration.

PUBLIC OUTREACH:

The public has been informed of this agenda item as part of the City's standard meeting notice practices via public bulletin boards, website calendar, and social media. In addition, the Chamber of Commerce and all persons previously expressing an interest in this subject have been sent an email inviting them to this meeting.

ENVIRONMENTAL REVIEW:

The City has reviewed the proposed activity for compliance with the California Environmental Quality Act (CEQA) and has determined that the project falls under the statutory exemption pursuant for a "Feasibility and Planning Study" as defined under Section 15262 of the State CEQA Guidelines. Thus, no environmental review is necessary.

ATTACHMENTS:

1. Potential Sepulveda Boulevard Safety Measures Table (Draft)
2. Safety Study Potential Measures Concept Plan
3. Crash History Map 1/1/2021-9/30/2025
4. Sepulveda Boulevard Engineering and Traffic Survey 7/19/2023
5. California State Priority Safety Corridor Initiative
6. Making Our Roads Safer-28 Proven Safety Countermeasures (FHWA)
7. Implementing the Safe Systems Approach (CalBerkley SafeTREC)
8. PowerPoint Presentation

City of Manhattan Beach
Potential Sepulveda Boulevard Safety Measures (DRAFT)
FOR PLANNING PURPOSES ONLY

#	DESCRIPTION	LEAD AGENCY	SCHEDULE	COST	NOTES
1	Construct ADA accessible curb ramps (various locations)	Caltrans	Short	\$\$\$	CAPM project
2	Install high visibility crosswalks (various locations)	Caltrans	Short	\$\$	CAPM project
3	Install high visibility crosswalks (various locations)	City	Short	\$\$	
4	Install pedestrian curb/barrier at corners (various locations)	Caltrans	Short	\$\$	Part of CAPM project
5	Install yield line, pedestrian warning and yield signs at Artesia Bl. Adjust and add extension lines in intersection.	Caltrans	Short	\$\$	CCO to CAPM project
6	Install vehicle sensor loops at three intersections (2 nd Street, 8 th Street, and Longfellow Ave)	Caltrans	Short	\$\$	CCO to CAPM project
7	Install leading pedestrian interval at intersections	Caltrans	Short	\$	Completed. This is standard operation for Caltrans.
8	Prohibit WB left turns at Tennyson St.*	City	Medium	\$	Skechers NTMP
9	Install limit line, KEEP CLEAR pavement markings NB and high visibility crosswalk at Keats St.	Caltrans	Short	\$	CCO to CAPM project
10	Prohibit EB left turns at 30th St (Hermosa Beach)	Hermosa Beach	Short	\$	In Hermosa Beach
11	Install bike lanes and sharrows on Longfellow Ave.	City	Medium	\$	Skechers NTMP (Remove parking)
12	Install No Ped Xing signs at Ronda Dr. in the center median.	Caltrans	Short	\$	CCO to CAPM project
13	Prohibit WB left turns at Ronda St. *	City	Medium	\$	Skechers NTMP
14	Install bike lanes and sharrows on 2 nd Street	City	Short	\$	Gelsons NTMP (Remove parking)
15	Install 35 MPH pavement markings NB and SB between 2 nd St. and 6 th St.	Caltrans	Short	\$	CCO to CAPM project
16	Install 35 MPH speed limit sign on NB and add additional sign prohibiting NB left turns 3-7PM M-F at 3 rd St.	Caltrans	Short	\$	CCO to CAPM project
17	Relocate speed feedback sign from 8 th St. to 3 rd St.	City	Short	\$	TBD
18	Install limit line and KEEP CLEAR pavement markings for NB lanes.	Caltrans	Short	\$	CCO to CAPM
18b	Prohibit EB left turns at 3 rd St.*	City	Short	\$	Gelsons NTMP
19	Prohibit WB left turns at 5 th St.*	City	Medium	\$	Gelsons NTMP
20	Prohibit EB left turns at 6 th St.*	City	Medium	\$	Gelsons NTMP
21	Install limit line and KEEP CLEAR pavement markings for NB lanes at 6 th St.*	Caltrans	Short	\$	CCO to CAPM
21b	Prohibit WB left turns at 6 th St.*	City	Short	\$	Gelsons NTMP
22	Install NB shoulder diagonal markings between 8 th St. to 9 th St.	Caltrans	Short	\$	CCO to CAPM project
23	Install bike lanes and sharrows on 8 th St.	City	Medium	\$\$	Gelsons NTMP (Widen street)
24	Prohibit WB and EB left turns at 10 th St.*	City	Medium	\$	Gelsons NTMP
25	Prohibit EB and WB left turns at 11 th St.*	City	Medium	\$\$	Existing City Project at MBB
26	Construct dual NB, EB and WB left turn pockets at MBB	City	Medium	\$\$\$\$	Existing City Project at MBB
27	Prohibit EB and WB left turns at 14 th St.*	City	Medium	\$	
28	Prohibit EB and WB left turns at 17 th St.*	City	Medium	\$	
29	Prohibit EB and WB left turns at 19 th St.*	City	Medium	\$	
30	Prohibit WB left turns at 22 nd St.*	City	Medium	\$	

Rev. 2/24/2026

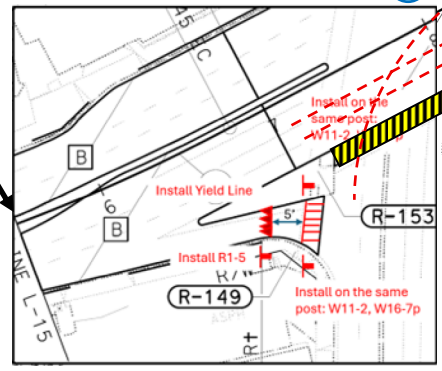
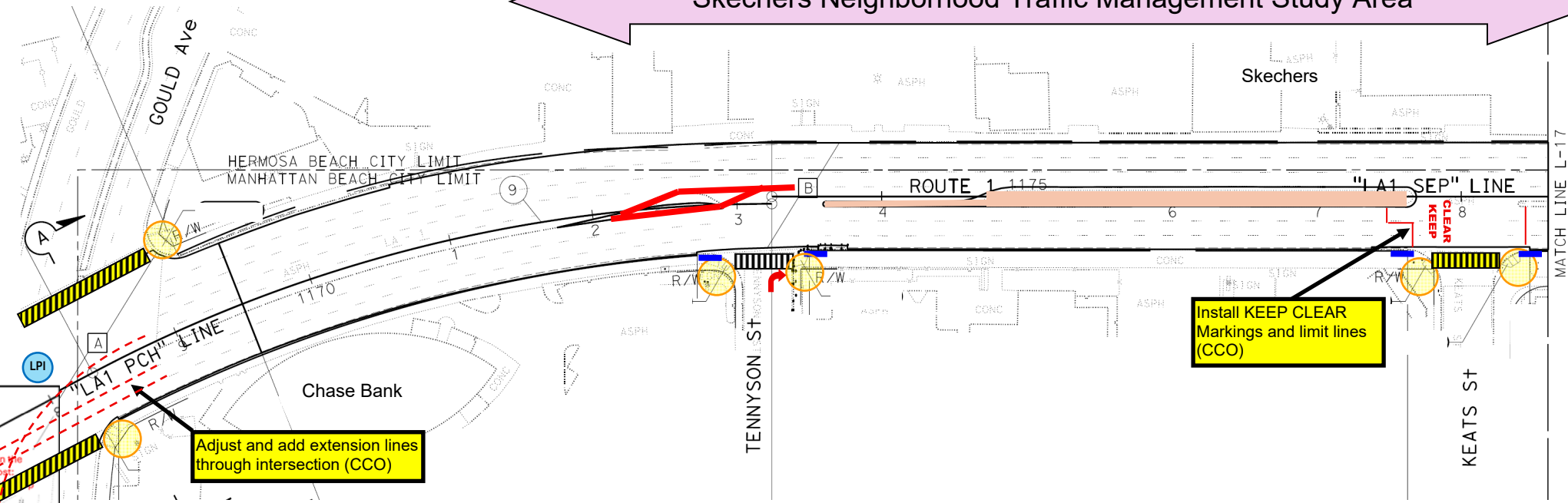
31	Install bike lanes and sharrows on Marine Ave.	City	Long	\$\$\$	Widen Street
32	Install bike lanes and sharrows on 30 th St.	City	Long	\$\$\$	MV shopping center driveway
33	Install sidewalks on 33 rd Street	City	Medium	\$\$\$	Existing City Project
34	Relocate poles and fire hydrant in sidewalk on 33 rd Street	City	Long	\$\$\$	
35	Construct bike path west of Veterans Parkway bridge	City	Long	\$\$\$	
36	Prohibit EB left turns at Valley Dr.*	City	Short	\$	
37	Reconfigure crosswalks at Rosecrans Ave with dual curb ramp	City	Medium	\$\$\$	New curb ramps, signal modification
38	Center median landscaping beautification on entire corridor	City	Medium	\$\$\$\$	Drought tolerant, remove obstructions
39	Construct pedestrian bridge between Duncan Dr and Ronda	Skechers	Long	\$\$\$\$	Proposed by Skechers
#	ENFORCEMENT	LEAD AGENCY	SCHEDULE	COST	NOTES
40	Conduct DUI checkpoints	City	Short	\$	July 2025, More in progress
41	Deploy video surveillance cameras with targeted enforcement	City	Short	\$	In progress
42	Pursue State Priority Corridor status	City			
#	EDUCATION	LEAD AGENCY	SCHEDULE	COST	NOTES
43	Deploy changeable message boards with educational messaging	City	Short	\$	In progress
44	Conduct social media and online educational campaign	City	Medium	\$	Consider logo and identity

NOTE * - Future raised center median to prohibit left turns. Additional studies required.

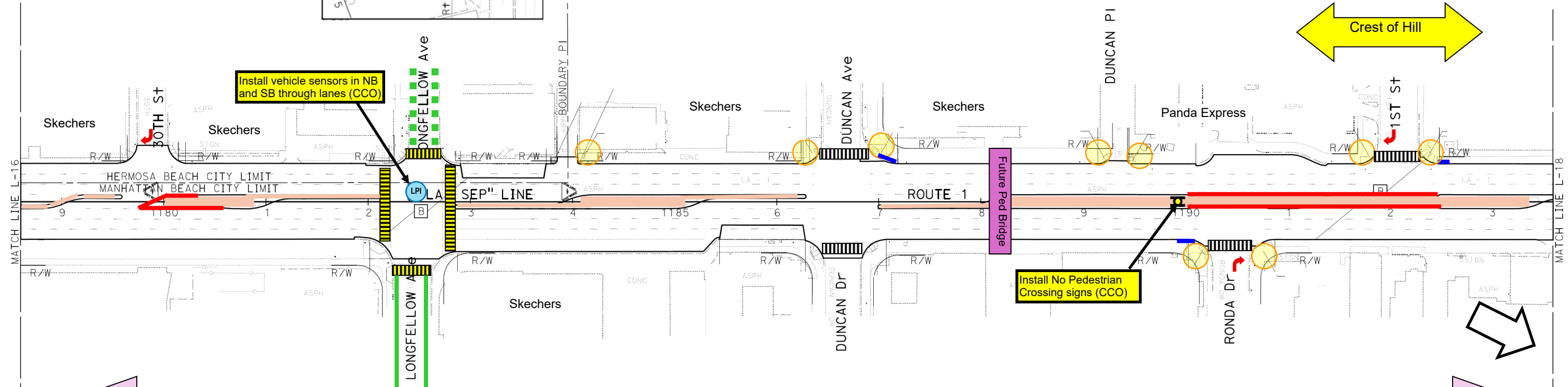
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- ADA Curb Ramp (Caltrans)
- High Visibility Crosswalk (Caltrans)
- High Visibility Crosswalk (Manhattan Beach)
- Pedestrian Curb/Barrier (Caltrans)
- Landscaping Beautification for Visibility
- Turn Restriction Island
- Bike Lanes
- Leading Ped Signal
- Street Lighting

← Skechers Neighborhood Traffic Management Study Area →

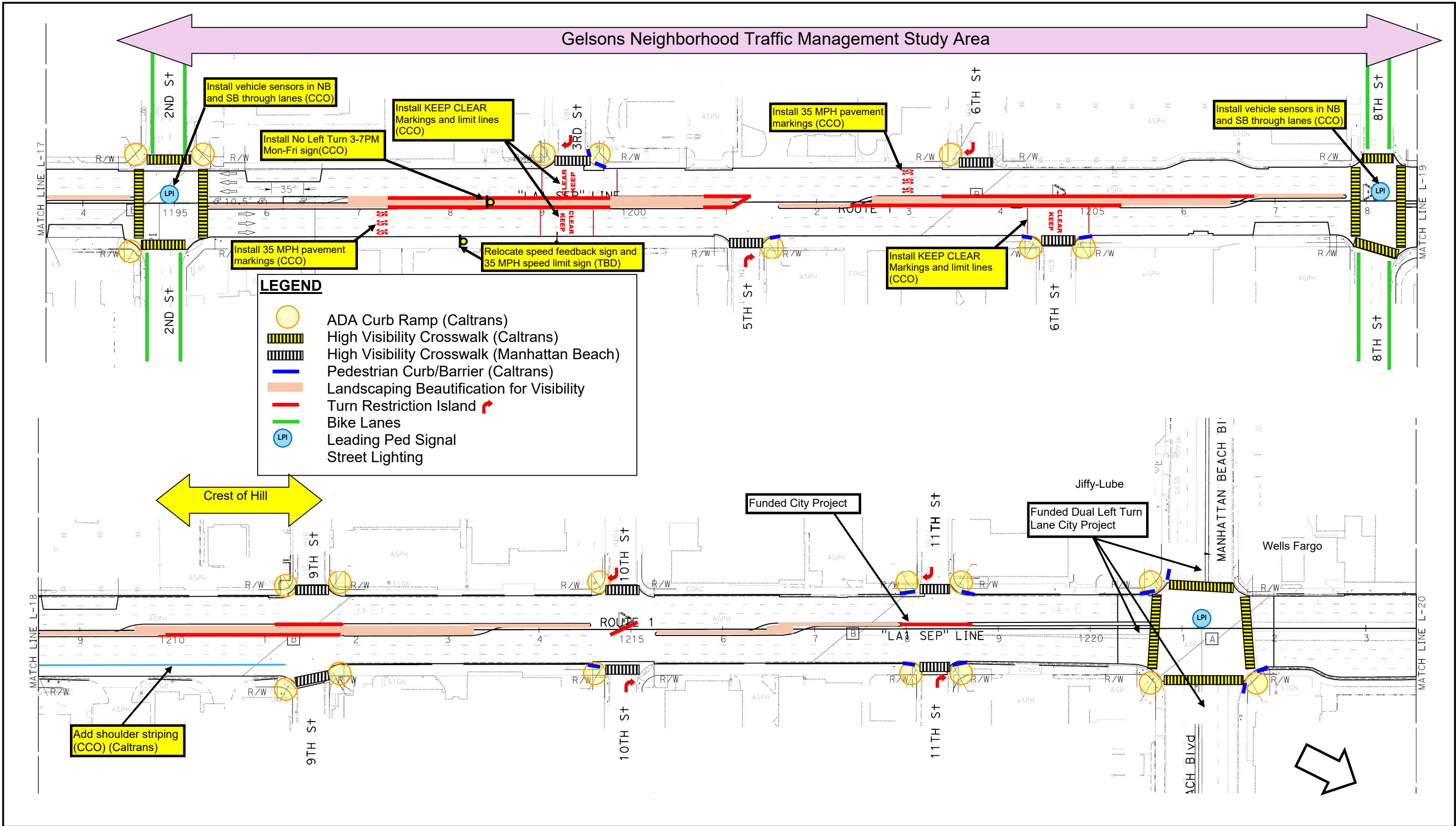


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← Skechers Neighborhood Traffic Management Study Area →

Gelsons Neighborhood Traffic Management Study Area

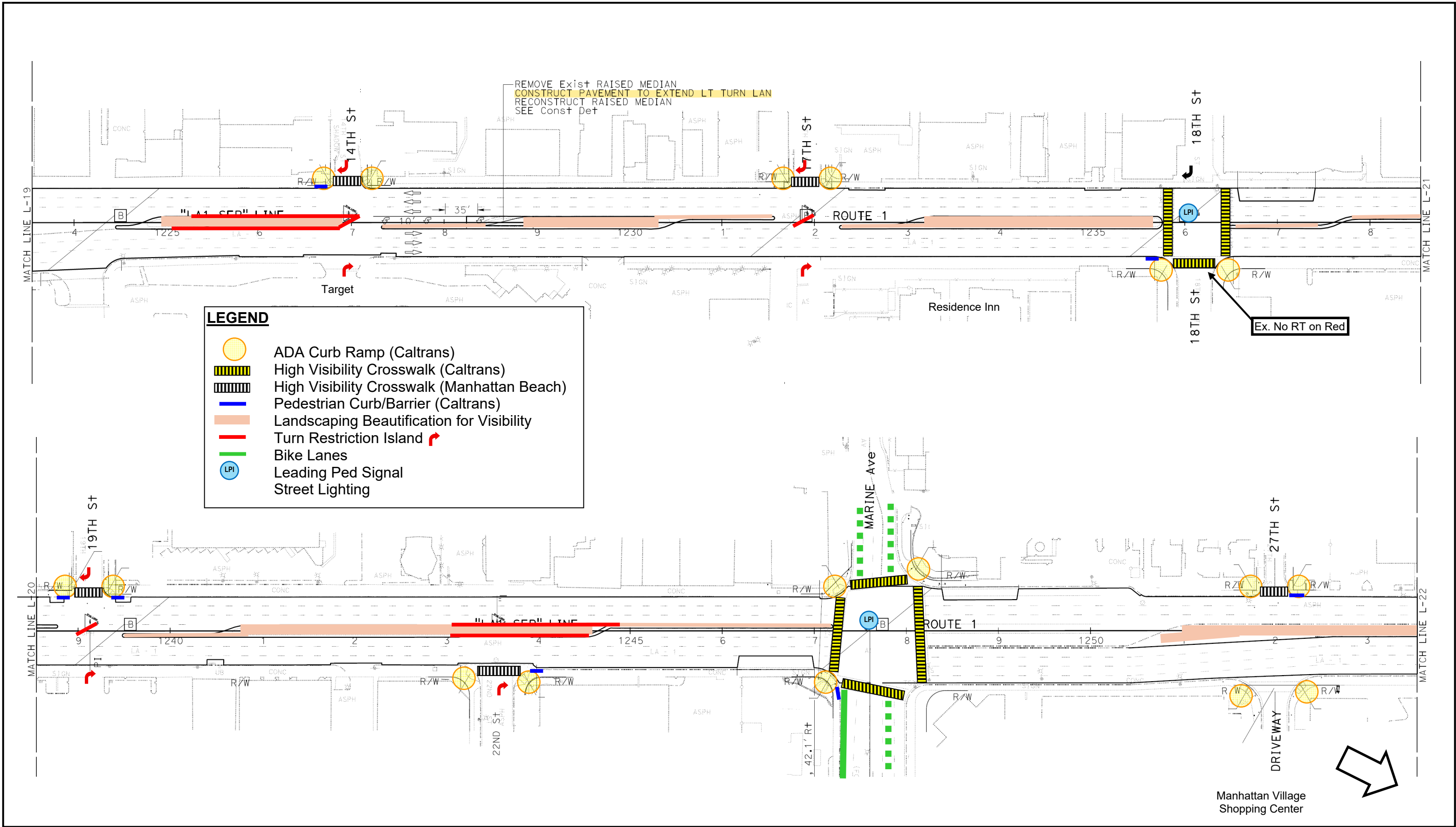


LEGEND

- ADA Curb Ramp (Caltrans)
- High Visibility Crosswalk (Caltrans)
- High Visibility Crosswalk (Manhattan Beach)
- Pedestrian Curb/Barrier (Caltrans)
- Landscaping Beautification for Visibility
- Turn Restriction Island
- Bike Lanes
- Leading Ped Signal Street Lighting

FOR PLANNING PURPOSES ONLY
Revised 03/16/2026

Sepulveda Boulevard (SR-1)
Safety Study Potential Measures
Sheet 2 of 4



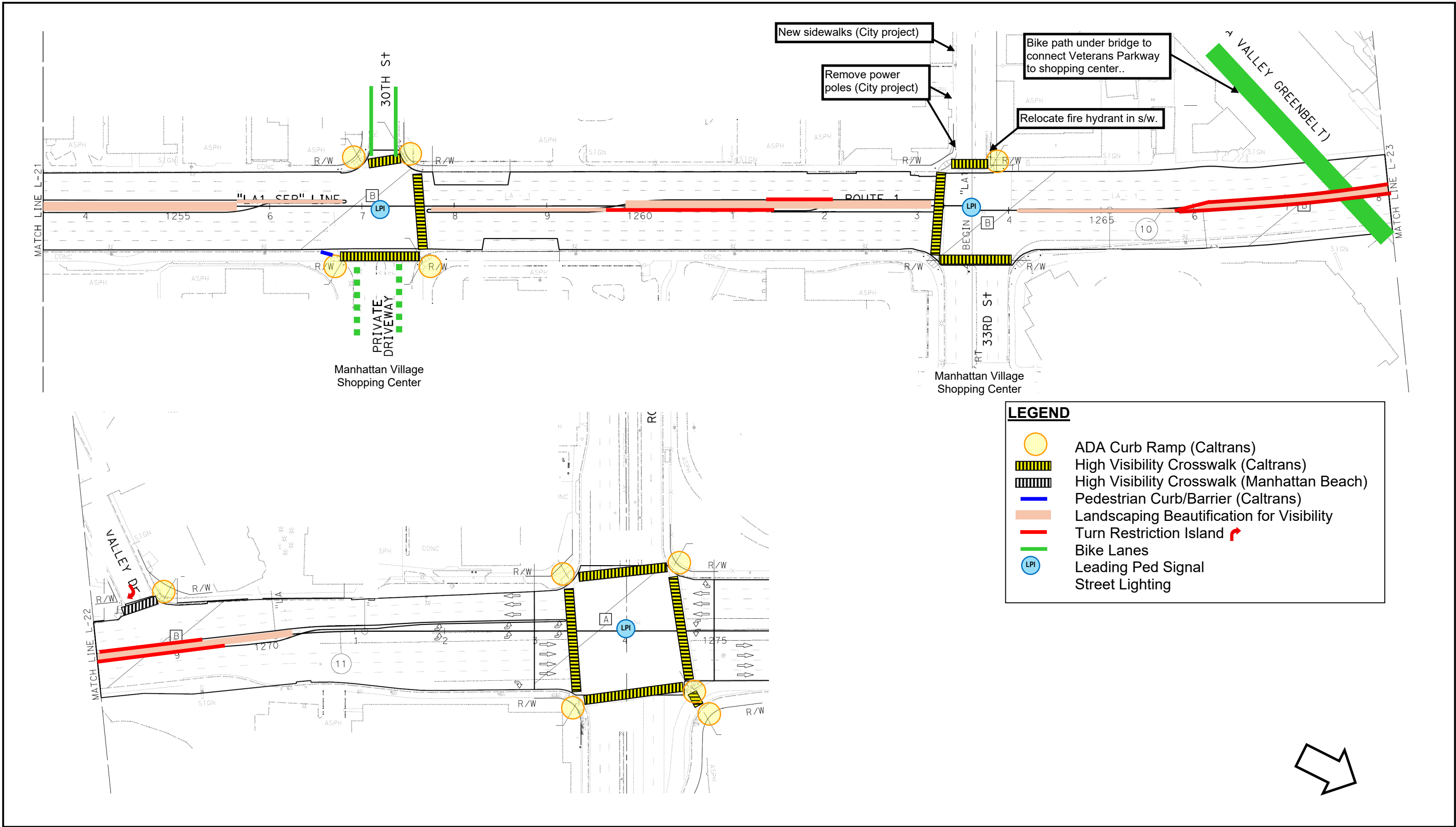
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LEGEND

- ADA Curb Ramp (Caltrans)
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- Pedestrian Curb/Barrier (Caltrans)
- Landscaping Beautification for Visibility
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Sepulveda Boulevard (SR-1)
 Safety Study Potential Measures
 Sheet 3 of 4

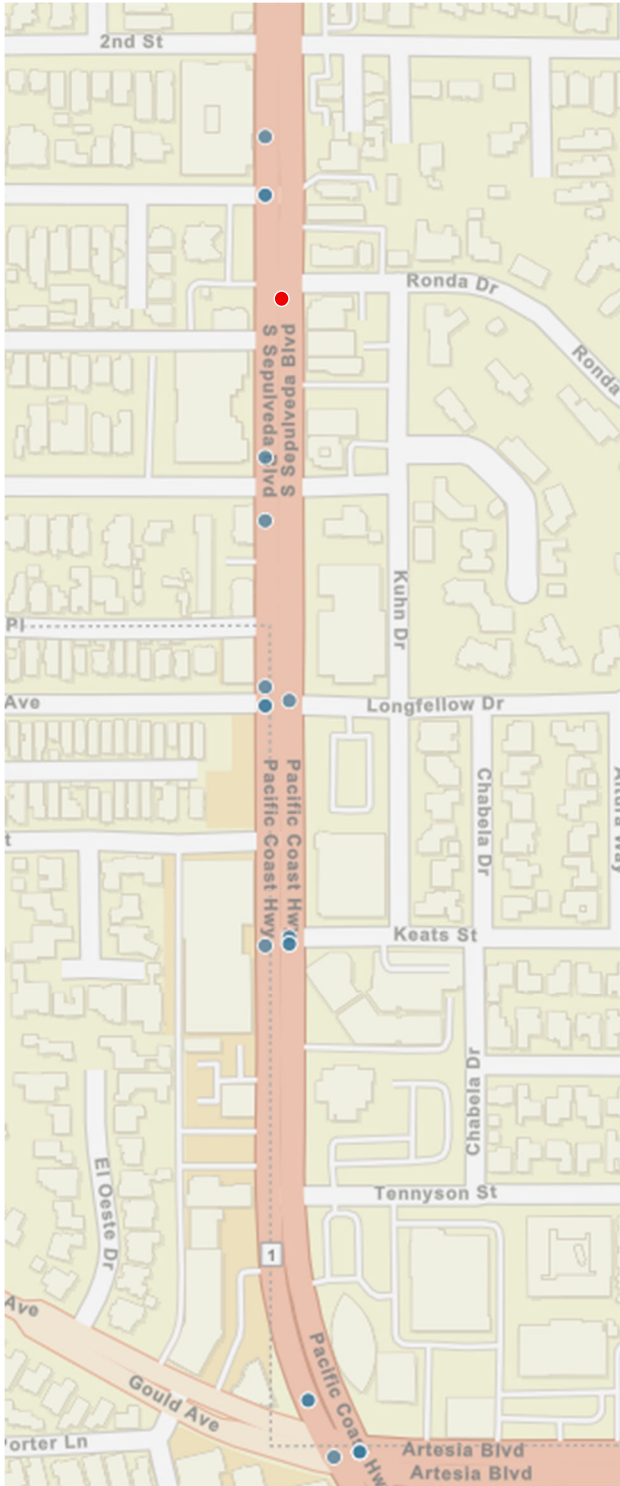


Fatal and Injury Crashes 1/1/2021 to 9/30/2025

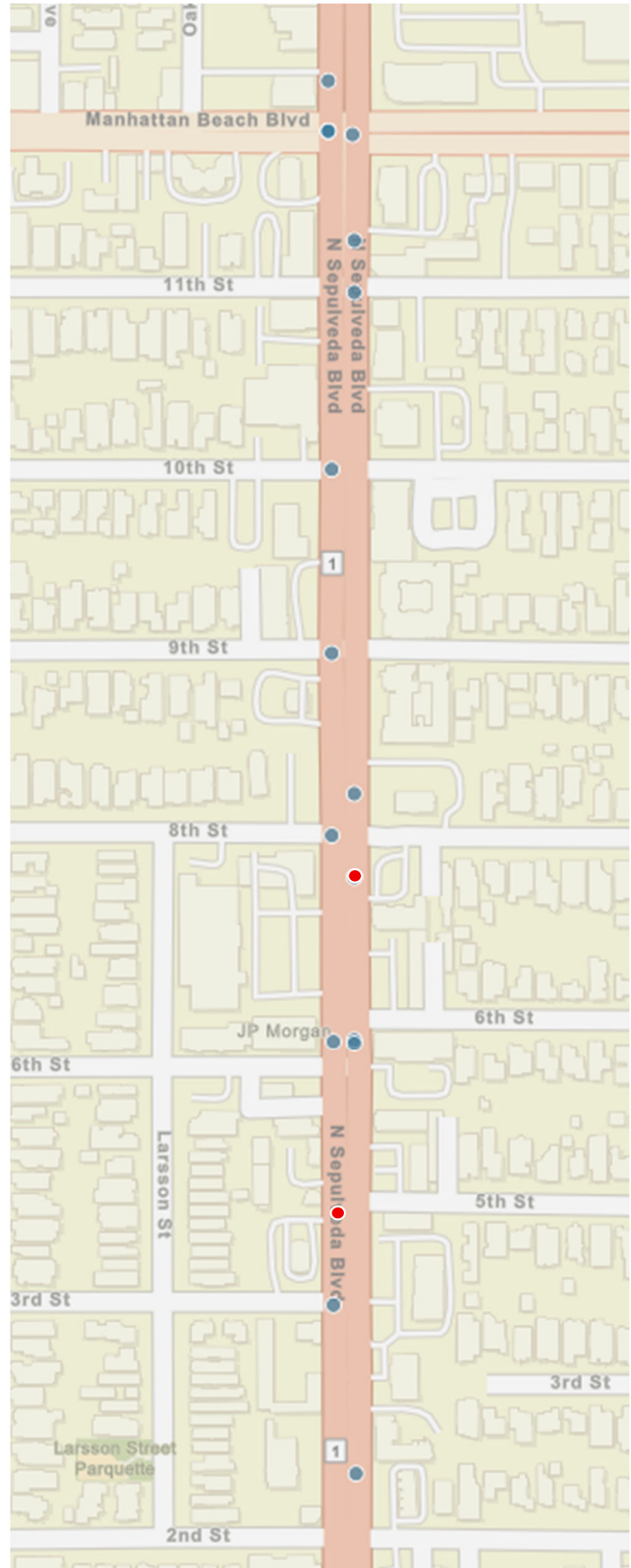
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- Injury Crash
- Fatal Crash

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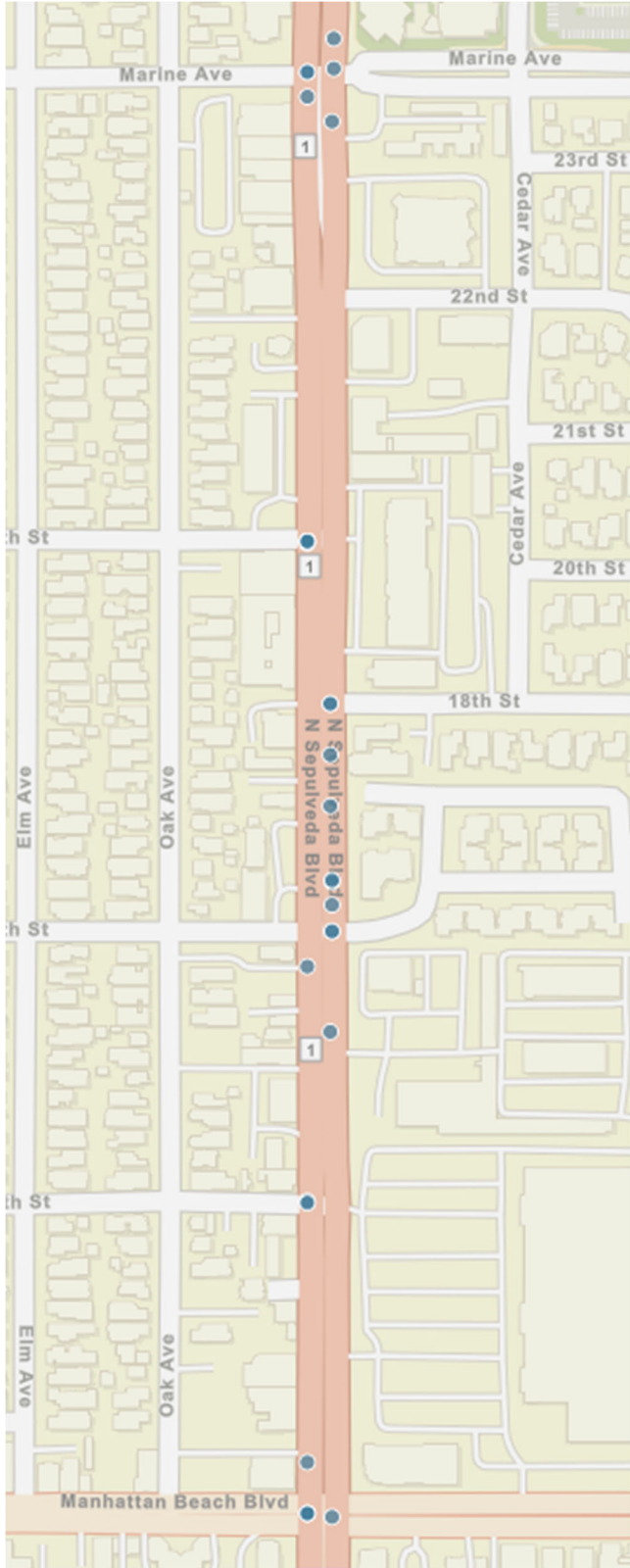


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Engineering and Traffic Survey (E&TS)

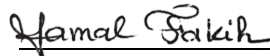
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Office of Transportation Safety

07/19/2023

DATE

Concurred by:



Sheik Moinuddin, P.E.
Chief (Acting)
Office of Transportation Safety

07/20/2023

DATE

I. BACKGROUND

This Engineering and Traffic Survey (E&TS) was conducted on State Route 1 (SR-1, Sepulveda Boulevard, Pacific Coast Highway, PCH), from north of Artesia Boulevard (PM 21.919) in the City of Manhattan Beach to Imperial Hwy (PM 25.921) in the City of El Segundo. The purpose of this E&TS is to update or revise the established speed limits as appropriate; the previous E&TS for the limits was conducted in August 2007.

This E&TS consists of obtaining vehicle speed samples and field survey data necessary to complete the vehicle speed survey sheets, including recommendation of appropriate speed based upon but not limited to field observations, critical speed, and accident history.

II. EXISTING CONDITIONS

A. GENERAL

SR-1 between Artesia Boulevard and Imperial Hwy is a part of major coastal artery that provided access to the major beach cities along the coast, an urban area and traverses through retail, commercial, industrial, and residential areas in the Cities of Manhattan Beach and El Segundo. Since the 2007 E&TS, there have been new housing developments and businesses along Sepulveda Boulevard.

B. TYPE OF FACILITY

Sepulveda Boulevard in the City of Manhattan Beach from Artesia Boulevard (PM 21.919) to Rosecrans Avenue (PM 23.924) is a six-lane conventional highway with raised median islands separating the northbound (NB) and southbound (SB) lanes. This segment of the highway has numerous driveways and alleys with a high number of pedestrians. There are left-turn pockets at all intersections and curb parking is allowed in some segments of Sepulveda Boulevard during non-peak hours.

Pacific Coast Highway (PCH) in the City of El Segundo from Rosecrans Avenue (PM 23.924) to Imperial Highway (PM 25.921) is eight-lane conventional highway with left-turn lanes. Raised median islands separating the NB and SB lanes. In this segment curb parking during non-peak hours is permitted on southbound from Grand Avenue to Sycamore Avenue only.

C. TRAFFIC

The highway carries a mix of residential, commuter, and through traffic. The 2020 Annual Average Daily Traffic (AADT) ranges from 41,500 to 56,000 vehicles per day.

D. EXISTING SPEED ZONES

The posted speed limits through the section are as follows:

Limits		Speed Limit	
From (Postmile)	To (Postmile)	NB MPH	SB MPH
Artesia Boulevard (PM 21.919)	Rosecrans Avenue (PM 23.924)	35	35
Rosecrans Avenue (PM 23.924)	El Segundo Boulevard (PM 24.911)	45	45
El Segundo Boulevard (PM 24.911)	Imperial Hwy (PM 25.921)	40	40

MPH – Miles Per hour

E. ACCIDENT RATES

The accident rates from the Traffic Accident Surveillance and Analysis System (TASAS) for the three-year period between, October 1, 2019, to September 30, 2022, for SR-1 within the survey limits are as follows:

Highway Segment (Postmile)		Accident Rate (Accidents/MVM)		Fatality Rate (Accidents/MVM)	
		Actual	Average	Actual	Average
Artesia Blvd (PM 21.919)	South of 22 nd Street (PM 23.331)	0.73	0.93	0.00	0.013
22 nd Street (PM 23.331)	Imperial Hwy (PM 25.921)	0.48	0.87	0.006	0.009

MVM = Million Vehicle Miles

F. ENFORCEMENT JURISDICTION

The City of Manhattan Beach Police Department and the City of El Segundo Police Department are the enforcement agencies within their respective city boundaries; these agencies use radar for speed enforcement.

G. SPEED ZONE FIELD DATA

Speed measurements were taken on February 17, February 19 and February 22, 2021. The results are shown in Attachment A.

III. COMMUNITY INVOLVEMENT

The results of this E&TS were shared with both City of Manhattan Beach and City of El Segundo for review and comment.

IV. CONCLUSIONS AND RECOMMENDATIONS

Based on field speed measurements, the 85th Percentile and 10 MPH Pace Speeds are shown in the table below:

Location of Speed Measurements	85 th Percentile Speed		10 MPH Pace Speed	
	NB	SB	NB	SB
Artesia Blvd (PM. 21.919)	37	34	28-37	26-35
Longfellow Avenue (PM 22.161)	31	39	22-31	30-39
3 rd Street (PM 22.461)	37	34	26-35	25-34
11 th Street (PM. 22.841)	41	39	32-41	30-39
Between 18 th (PM 23.191) and 22 nd Street (PM 23.3)	39	40	27-36	31-40
Rosecrans Avenue (PM 23.924)	39	38	26-35	29-38
El Segundo Boulevard (24.911)	47	42	37-46	31-40
N/O Mariposa (PM 25.441)	38	36	30-39	28-37
Imperial Highway (PM 25.921)	38	42	30-39	30-39

N/O = North of; S/O = South of

Based on the review of collision history, highway surveillance, traffic analysis, and roadway geometry, the proposed speed limits are shown in the table below:

Limits		Existing Speed Limit		Proposed Speed Limits	
From (Postmile)	To (Postmile)	NB MPH	SB MPH	NB MPH	SB MPH
Artesia Blvd (PM. 21.919)	Rosecrans Avenue (PM 23.924)	35	35	35	35
Rosecrans Avenue (PM 23.924)	El Segundo Blvd (PM 24.911)	45	45	40	40
El Segundo Blvd (PM 24.911)	Imperial Hwy (PM 25.921)	40	40	40	40

City of Manhattan Beach, Artesia Boulevard to Rosecrans Avenue (PM 21.919 to PM 23.92):

The average 85th percentile speed for this segment is 37 MPH in the NB direction and 38 MPH in the SB direction. The actual accident rate is lower than state average for similar facilities. It is recommended that the existing NB and SB speed limit of 35 MPH be retained for this segment

City of El Segundo, Rosecrans Avenue to El Segundo Boulevard (PM 23.924 to PM 24.911):

The average 85th percentile speed on this segment is 43 MPH in the NB direction and 40 MPH in SB direction. It is recommended that the existing speed of 45 MPH be reduced to 40 MPH for the NB and SB directions due to the following factors:

- The 85th percentile average speed is 43 MPH in the NB direction and 40 MPH in SB direction.
- There are horizontal curves along the roadway that may pose visibility issue at higher speed.
- There are driveways with restricted visibility.
- Railroad in the area may increase potentials for traffic conflicts.

City of El Segundo, El Segundo Boulevard to Imperial Hwy (PM 24.911 to PM 25.921):

The average 85th percentile speed on this segment is 41 MPH in the NB direction and 40 MPH in the SB direction. It is recommended that the existing NB and SB speed limit of 40 MPH be retained for this segment

V. ATTACHMENTS

- A. Vehicle Speed Survey Sheets
- B. Speed Zone Survey Layout Sheets

VEHICLE SPEED SURVEY SHEETS

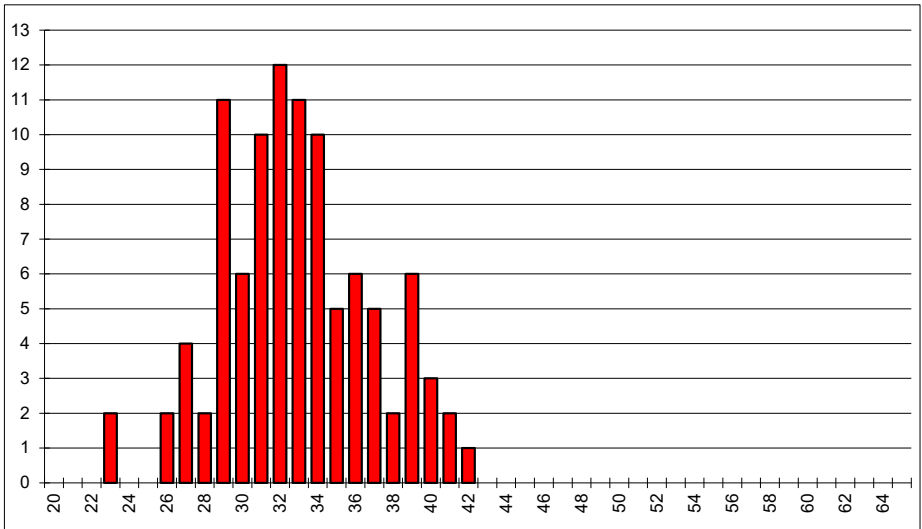
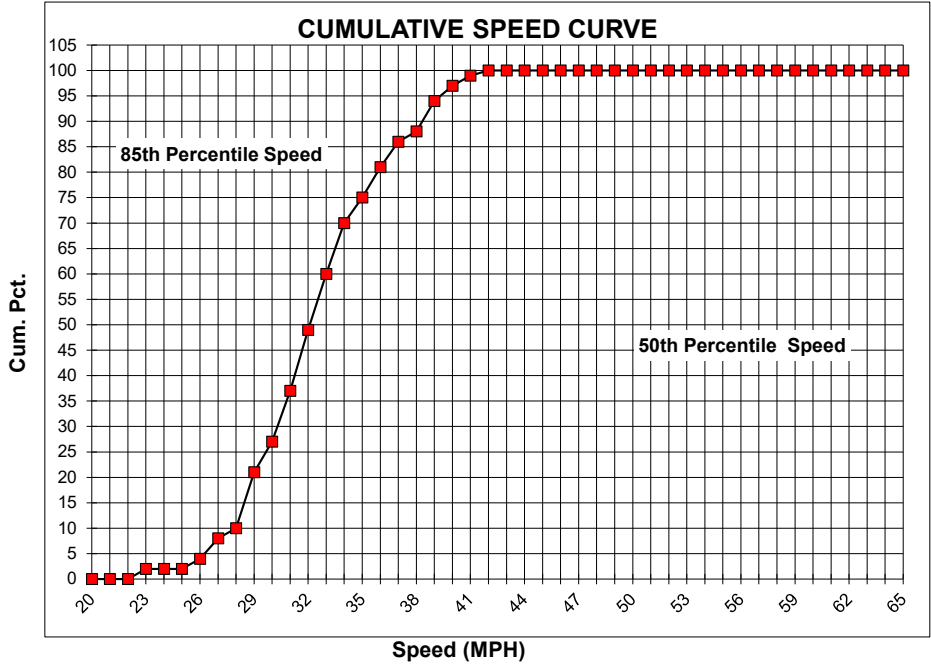
SPEED ZONE SURVEY LAYOUT SHEETS

STATE OF CALIFORNIA
 BUSINESS, TRANSPORTATION AND HOUSING AGENCY
 DEPARTMENT OF TRANSPORTATION
 CALTRANS DISTRICT 7
 OFFICE OF TRAFFIC MANAGEMENT

LOCATION: **NB PCH at Artesia Blvd**
 P.M.: **21.919**
 DIRECTION(S): **NB** ROUTE: **1**
 DATE: **2/17/2021** TIME: **11:35 AM**
 POSTED SPEED LIMITS: **35** OBSERVER: **AM, WH**
 WEATHER: **Clear and sunny**

50th Percentile Speed	33.0	10 MPH Pace Speed	28 to 37
85th Percentile Speed	37.0	Percent in Pace Speed	78
Number of Vehicles Observed	100	Percent over Pace Speed	14
Average Speed	33	Percent under Pace Speed	8
Range of Speeds	23 to 42		

Speed (MPH)	NO. (cars)	Pct. (%)	Cum. Pct. (%)
20	0	0	0
21	0	0	0
22	0	0	0
23	2	2	2
24	0	0	2
25	0	0	2
26	2	2	4
27	4	4	8
28	2	2	10
29	11	11	21
30	6	6	27
31	10	10	37
32	12	12	49
33	11	11	60
34	10	10	70
35	5	5	75
36	6	6	81
37	5	5	86
38	2	2	88
39	6	6	94
40	3	3	97
41	2	2	99
42	1	1	100
43	0	0	100
44	0	0	100
45	0	0	100
46	0	0	100
47	0	0	100
48	0	0	100
49	0	0	100
50	0	0	100
51	0	0	100
52	0	0	100
53	0	0	100
54	0	0	100
55	0	0	100
56	0	0	100
57	0	0	100
58	0	0	100
59	0	0	100
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61	0	0	100
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63	0	0	100
64	0	0	100
65	0	0	100



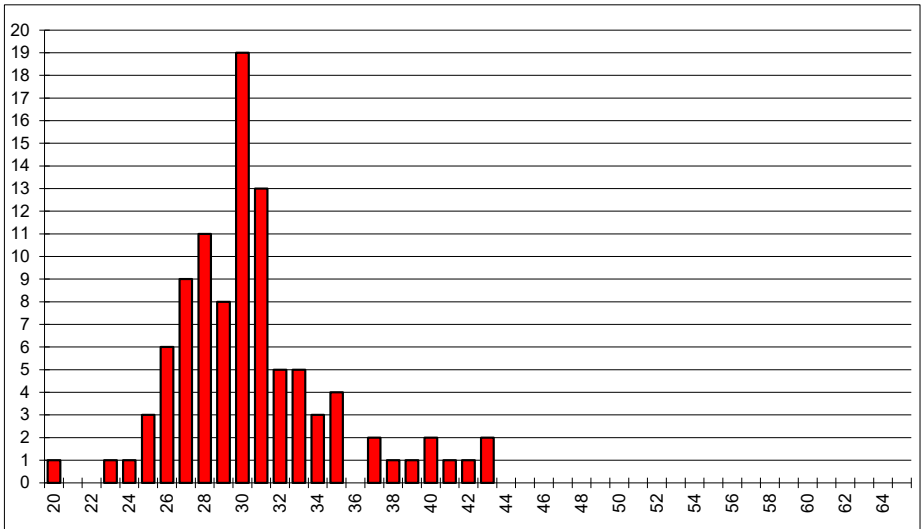
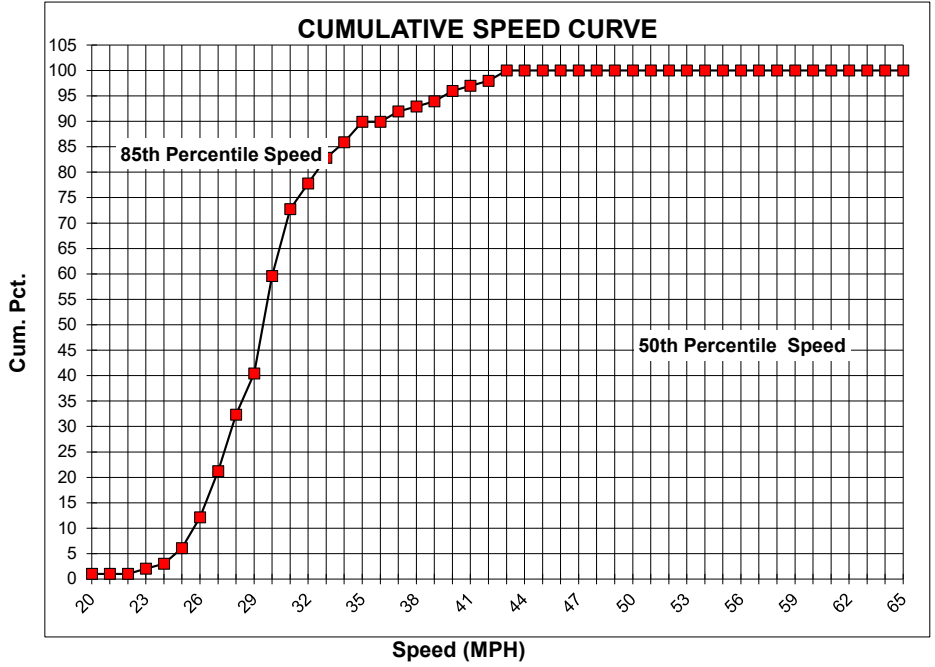
VEHICLE SPEED SURVEY SHEET

STATE OF CALIFORNIA
 BUSINESS, TRANSPORTATION AND HOUSING AGENCY
 DEPARTMENT OF TRANSPORTATION
 CALTRANS DISTRICT 7
 OFFICE OF TRAFFIC MANAGEMENT

LOCATION: **NB PCH at Artesia Blvd**
 P.M.: **21.919**
 DIRECTION(S): **SB** ROUTE: **1**
 DATE: **2/17/2021** TIME: **11:41 AM**
 POSTED SPEED LIMITS: **35** OBSERVER: **AM, WH**
 WEATHER: **Clear and sunny**

50th Percentile Speed	30.0	10 MPH Pace Speed	26 to 35
85th Percentile Speed	34.0	Percent in Pace Speed	84
Number of Vehicles Observed	99	Percent over Pace Speed	10
Average Speed	31	Percent under Pace Speed	6
Range of Speeds	20 to 43		

Speed (MPH)	NO. (cars)	Pct. (%)	Cum. Pct. (%)
20	1	1	1
21	0	0	1
22	0	0	1
23	1	1	2
24	1	1	3
25	3	3	6
26	6	6	12
27	9	9	21
28	11	11	32
29	8	8	40
30	19	19	60
31	13	13	73
32	5	5	78
33	5	5	83
34	3	3	86
35	4	4	90
36	0	0	90
37	2	2	92
38	1	1	93
39	1	1	94
40	2	2	96
41	1	1	97
42	1	1	98
43	2	2	100
44	0	0	100
45	0	0	100
46	0	0	100
47	0	0	100
48	0	0	100
49	0	0	100
50	0	0	100
51	0	0	100
52	0	0	100
53	0	0	100
54	0	0	100
55	0	0	100
56	0	0	100
57	0	0	100
58	0	0	100
59	0	0	100
60	0	0	100
61	0	0	100
62	0	0	100
63	0	0	100
64	0	0	100
65	0	0	100



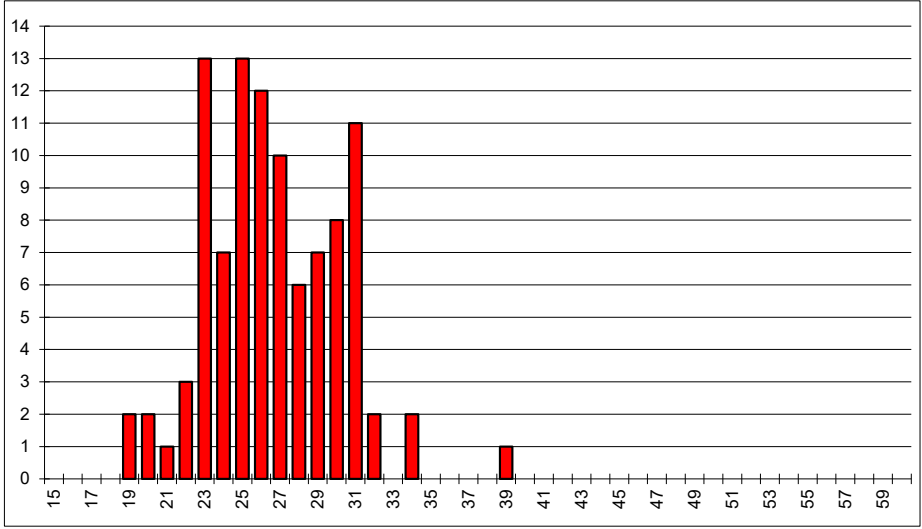
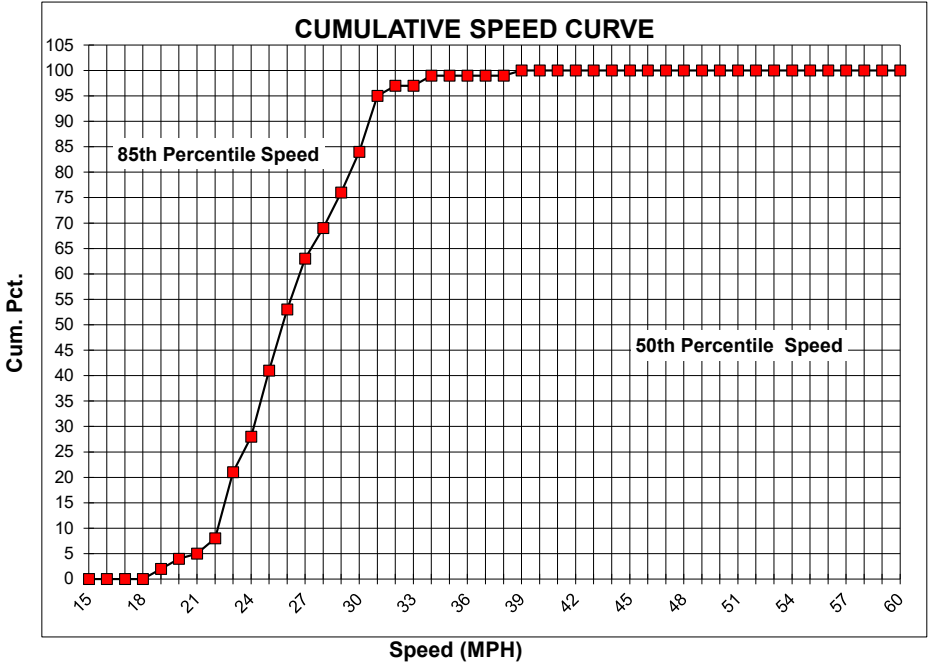
VEHICLE SPEED SURVEY SHEET

STATE OF CALIFORNIA
 BUSINESS, TRANSPORTATION AND HOUSING AGENCY
 DEPARTMENT OF TRANSPORTATION
 CALTRANS DISTRICT 7
 OFFICE OF TRAFFIC MANAGEMENT

LOCATION: **NB PCH at Longfellow Ave.**
 P.M.: **22.161**
 DIRECTION(S): **NB** ROUTE: **1**
 DATE: **2/17/2021** TIME: **10:15 AM**
 POSTED SPEED LIMITS: **35** OBSERVER: **AM, WH**
 WEATHER: **Clear and sunny**

50th Percentile Speed	26.0	10 MPH Pace Speed	22 to 31
85th Percentile Speed	31.0	Percent in Pace Speed	90
Number of Vehicles Observed	100	Percent over Pace Speed	5
Average Speed	27	Percent under Pace Speed	5
Range of Speeds	19 to 39		

Speed (MPH)	NO. (cars)	Pct. (%)	Cum. Pct. (%)
15	0	0	0
16	0	0	0
17	0	0	0
18	0	0	0
19	2	2	2
20	2	2	4
21	1	1	5
22	3	3	8
23	13	13	21
24	7	7	28
25	13	13	41
26	12	12	53
27	10	10	63
28	6	6	69
29	7	7	76
30	8	8	84
31	11	11	95
32	2	2	97
33	0	0	97
34	2	2	99
35	0	0	99
36	0	0	99
37	0	0	99
38	0	0	99
39	1	1	100
40	0	0	100
41	0	0	100
42	0	0	100
43	0	0	100
44	0	0	100
45	0	0	100
46	0	0	100
47	0	0	100
48	0	0	100
49	0	0	100
50	0	0	100
51	0	0	100
52	0	0	100
53	0	0	100
54	0	0	100
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57	0	0	100
58	0	0	100
59	0	0	100
60	0	0	100



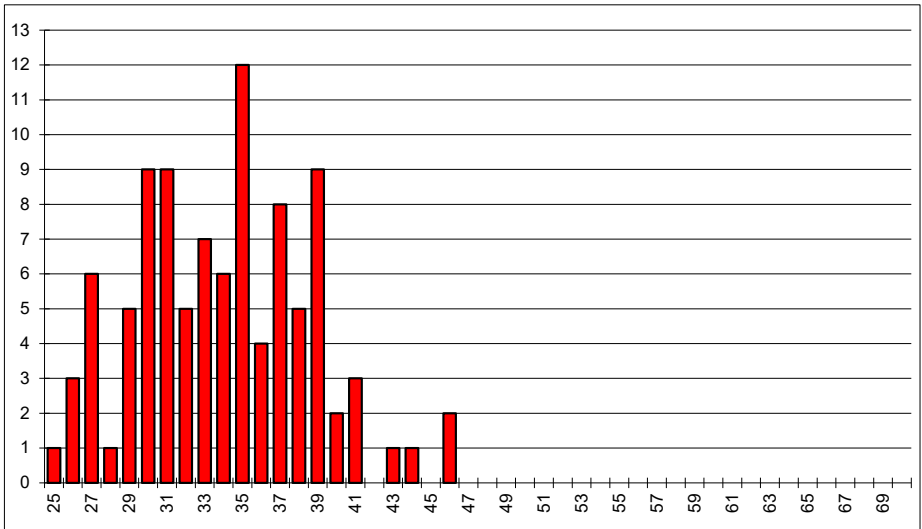
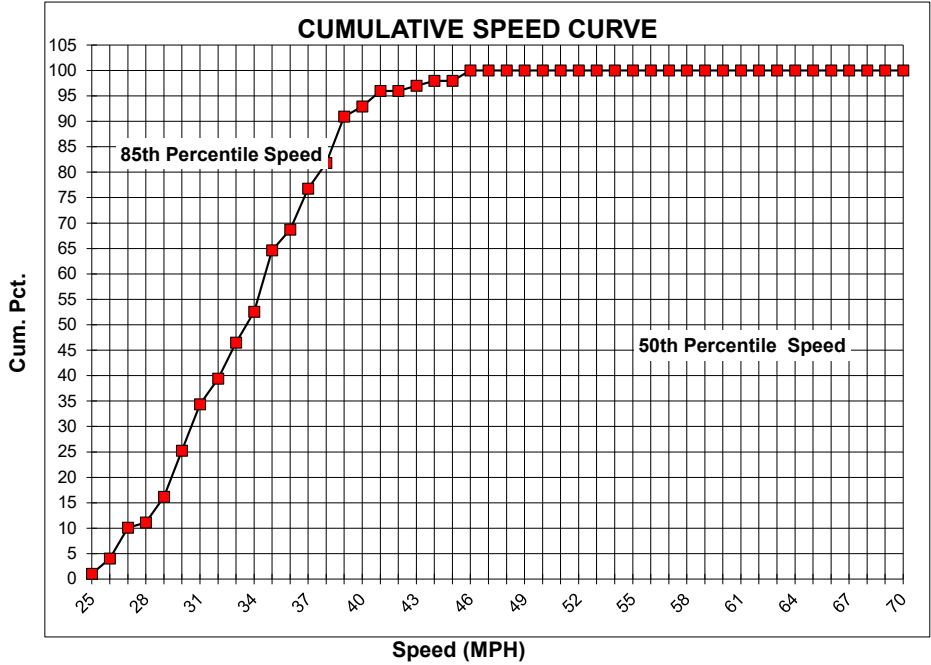
VEHICLE SPEED SURVEY SHEET

STATE OF CALIFORNIA
 BUSINESS, TRANSPORTATION AND HOUSING AGENCY
 DEPARTMENT OF TRANSPORTATION
 CALTRANS DISTRICT 7
 OFFICE OF TRAFFIC MANAGEMENT

LOCATION: **NB PCH at Longfellow Ave.**
 P.M.: **22.161**
 DIRECTION(S): **SB** ROUTE: **1**
 DATE: **2/17/2021** TIME: **10:03 AM**
 POSTED SPEED LIMITS: **35** OBSERVER: **AM, WH**
 WEATHER: **Clear and sunny**

50th Percentile Speed	34.0	10 MPH Pace Speed	30 to 39
85th Percentile Speed	39.0	Percent in Pace Speed	75
Number of Vehicles Observed	99	Percent over Pace Speed	9
Average Speed	34	Percent under Pace Speed	16
Range of Speeds	25 to 46		

Speed (MPH)	NO. (cars)	Pct. (%)	Cum. Pct. (%)
25	1	1	1
26	3	3	4
27	6	6	10
28	1	1	11
29	5	5	16
30	9	9	25
31	9	9	34
32	5	5	39
33	7	7	46
34	6	6	53
35	12	12	65
36	4	4	69
37	8	8	77
38	5	5	82
39	9	9	91
40	2	2	93
41	3	3	96
42	0	0	96
43	1	1	97
44	1	1	98
45	0	0	98
46	2	2	100
47	0	0	100
48	0	0	100
49	0	0	100
50	0	0	100
51	0	0	100
52	0	0	100
53	0	0	100
54	0	0	100
55	0	0	100
56	0	0	100
57	0	0	100
58	0	0	100
59	0	0	100
60	0	0	100
61	0	0	100
62	0	0	100
63	0	0	100
64	0	0	100
65	0	0	100
66	0	0	100
67	0	0	100
68	0	0	100
69	0	0	100
70	0	0	100



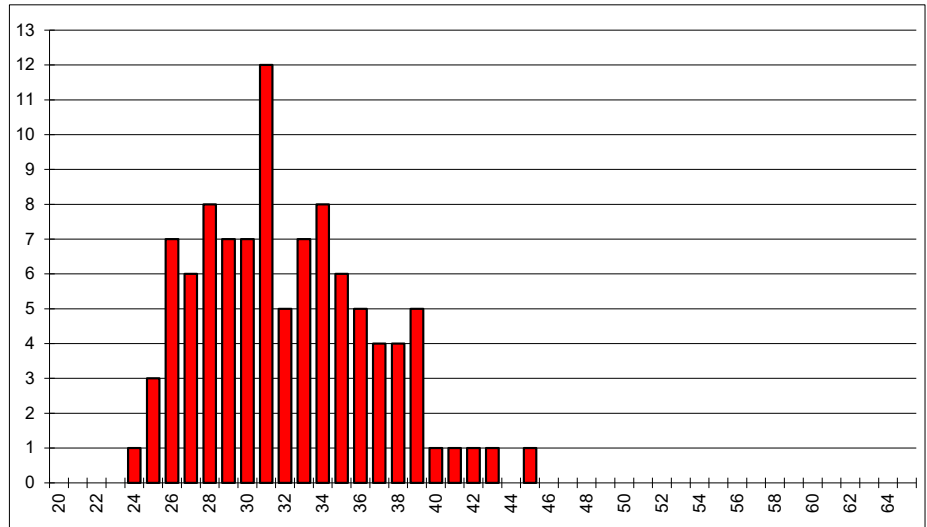
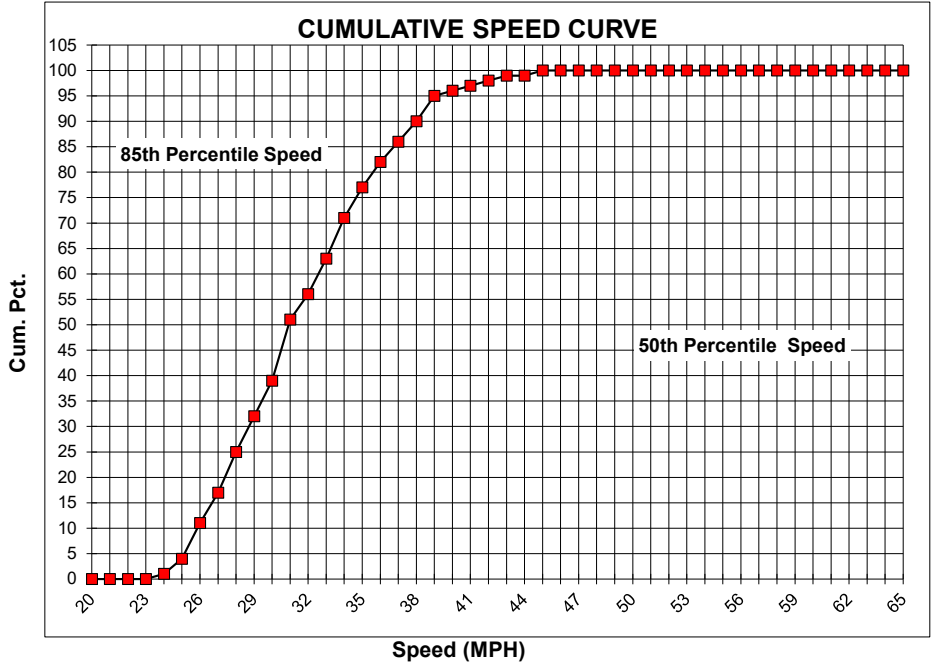
VEHICLE SPEED SURVEY SHEET

STATE OF CALIFORNIA
 BUSINESS, TRANSPORTATION AND HOUSING AGENCY
 DEPARTMENT OF TRANSPORTATION
 CALTRANS DISTRICT 7
 OFFICE OF TRAFFIC MANAGEMENT

LOCATION: **NB PCH at 3rd St.**
 P.M.: **22.461**
 DIRECTION(S): **SB** ROUTE: **1**
 DATE: **2/17/2021** TIME: **10:20 AM**
 POSTED SPEED LIMITS: **35** OBSERVER: **AM, WH**
 WEATHER: **Clear and sunny**

50th Percentile Speed	31.0	10 MPH Pace Speed	26 to 35
85th Percentile Speed	37.0	Percent in Pace Speed	73
Number of Vehicles Observed	100	Percent over Pace Speed	23
Average Speed	32	Percent under Pace Speed	4
Range of Speeds	24 to 45		

Speed (MPH)	NO. (cars)	Pct. (%)	Cum. Pct. (%)
20	0	0	0
21	0	0	0
22	0	0	0
23	0	0	0
24	1	1	1
25	3	3	4
26	7	7	11
27	6	6	17
28	8	8	25
29	7	7	32
30	7	7	39
31	12	12	51
32	5	5	56
33	7	7	63
34	8	8	71
35	6	6	77
36	5	5	82
37	4	4	86
38	4	4	90
39	5	5	95
40	1	1	96
41	1	1	97
42	1	1	98
43	1	1	99
44	0	0	99
45	1	1	100
46	0	0	100
47	0	0	100
48	0	0	100
49	0	0	100
50	0	0	100
51	0	0	100
52	0	0	100
53	0	0	100
54	0	0	100
55	0	0	100
56	0	0	100
57	0	0	100
58	0	0	100
59	0	0	100
60	0	0	100
61	0	0	100
62	0	0	100
63	0	0	100
64	0	0	100
65	0	0	100



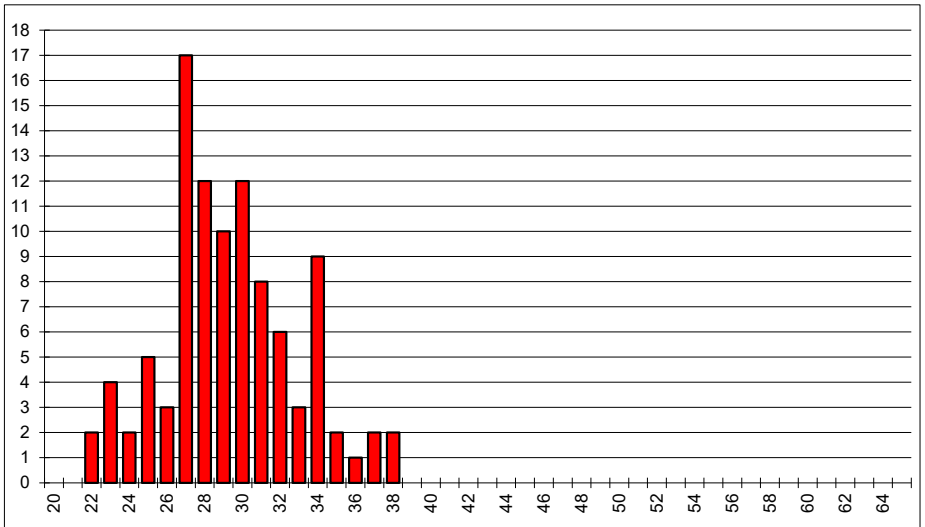
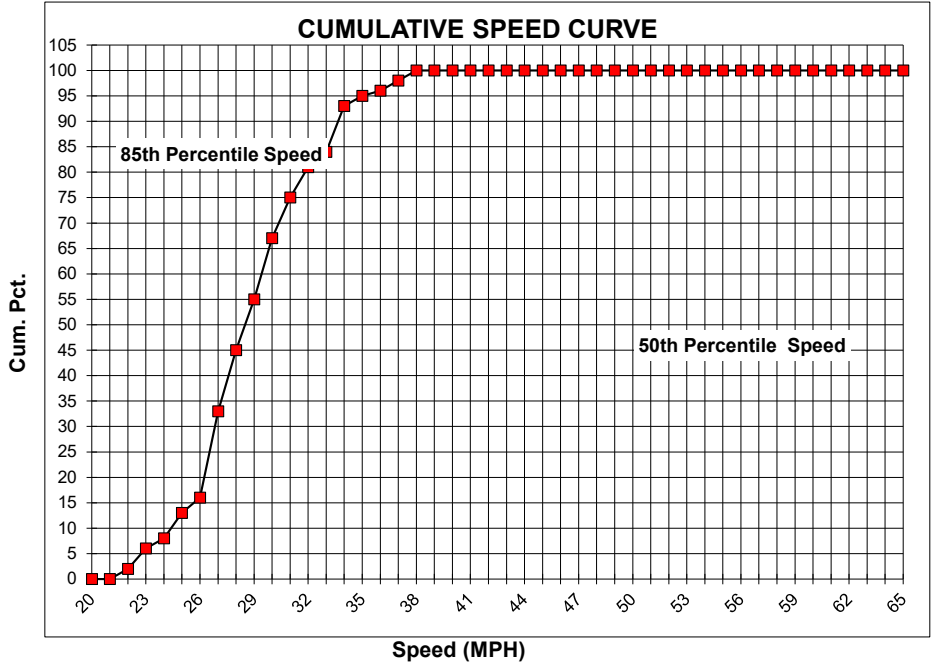
VEHICLE SPEED SURVEY SHEET

STATE OF CALIFORNIA
 BUSINESS, TRANSPORTATION AND HOUSING AGENCY
 DEPARTMENT OF TRANSPORTATION
 CALTRANS DISTRICT 7
 OFFICE OF TRAFFIC MANAGEMENT

LOCATION: **NB PCH at 3rd St.**
 P.M.: **22.461**
 DIRECTION(S): **SB** ROUTE: **1**
 DATE: **2/17/2021** TIME: **10:45 AM**
 POSTED SPEED LIMITS: **35** OBSERVER: **AM, WH**
 WEATHER: **Clear and sunny**

50th Percentile Speed	29.0	10 MPH Pace Speed	25 to 34
85th Percentile Speed	34.0	Percent in Pace Speed	85
Number of Vehicles Observed	100	Percent over Pace Speed	7
Average Speed	29	Percent under Pace Speed	8
Range of Speeds	22 to 38		

Speed (MPH)	NO. (cars)	Pct. (%)	Cum. Pct. (%)
20	0	0	0
21	0	0	0
22	2	2	2
23	4	4	6
24	2	2	8
25	5	5	13
26	3	3	16
27	17	17	33
28	12	12	45
29	10	10	55
30	12	12	67
31	8	8	75
32	6	6	81
33	3	3	84
34	9	9	93
35	2	2	95
36	1	1	96
37	2	2	98
38	2	2	100
39	0	0	100
40	0	0	100
41	0	0	100
42	0	0	100
43	0	0	100
44	0	0	100
45	0	0	100
46	0	0	100
47	0	0	100
48	0	0	100
49	0	0	100
50	0	0	100
51	0	0	100
52	0	0	100
53	0	0	100
54	0	0	100
55	0	0	100
56	0	0	100
57	0	0	100
58	0	0	100
59	0	0	100
60	0	0	100
61	0	0	100
62	0	0	100
63	0	0	100
64	0	0	100
65	0	0	100



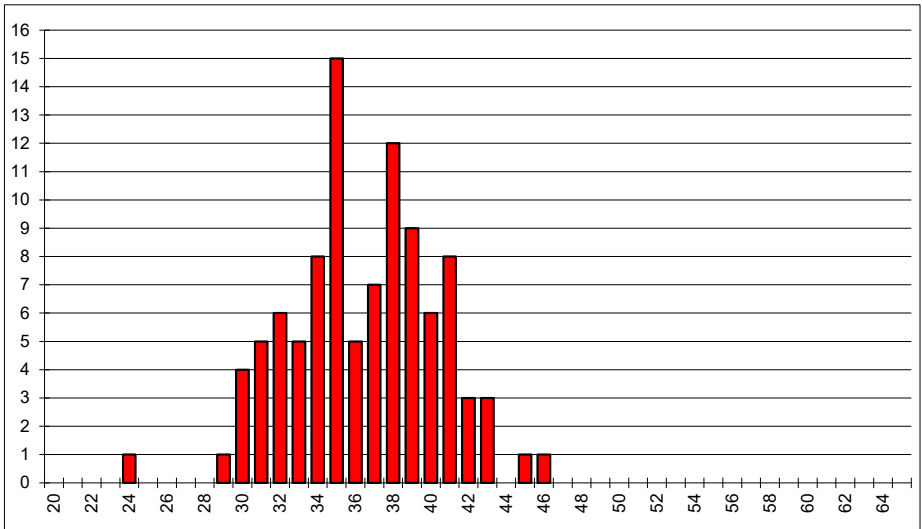
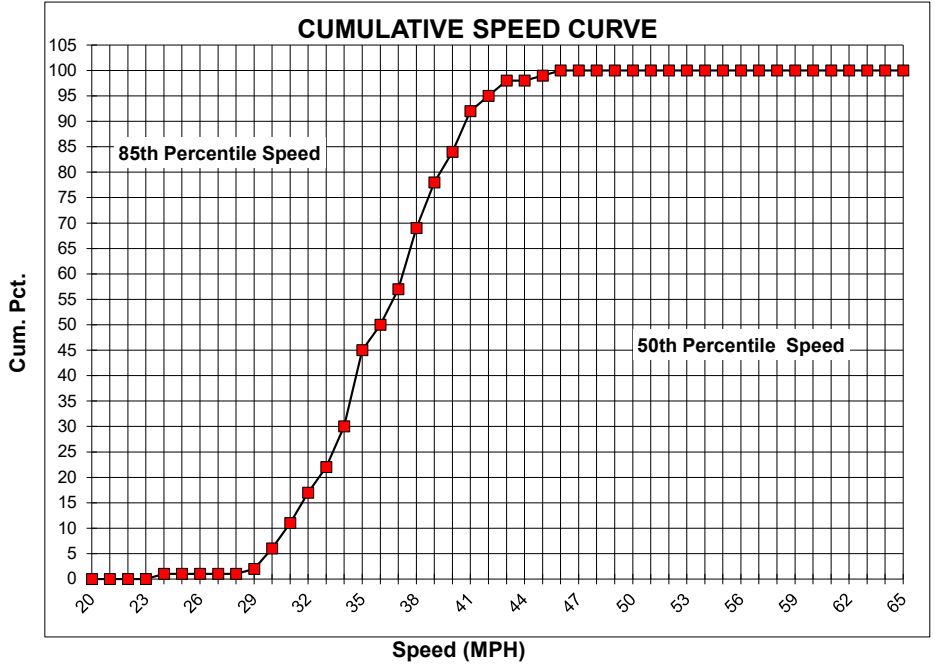
VEHICLE SPEED SURVEY SHEET

STATE OF CALIFORNIA
 BUSINESS, TRANSPORTATION AND HOUSING AGENCY
 DEPARTMENT OF TRANSPORTATION
 CALTRANS DISTRICT 7
 OFFICE OF TRAFFIC MANAGEMENT

LOCATION: **NB PCH at 11th St.**
 P.M.: **22.841**
 DIRECTION(S): **NB** ROUTE: **1**
 DATE: **2/17/2021** TIME: **11:07 AM**
 POSTED SPEED LIMITS: **35** OBSERVER: **AM, WH**
 WEATHER: **Clear and sunny**

50th Percentile Speed	36.0	10 MPH Pace Speed	32 to 41
85th Percentile Speed	41.0	Percent in Pace Speed	81
Number of Vehicles Observed	100	Percent over Pace Speed	8
Average Speed	36	Percent under Pace Speed	11
Range of Speeds	24 to 46		

Speed (MPH)	NO. (cars)	Pct. (%)	Cum. Pct. (%)
20	0	0	0
21	0	0	0
22	0	0	0
23	0	0	0
24	1	1	1
25	0	0	1
26	0	0	1
27	0	0	1
28	0	0	1
29	1	1	2
30	4	4	6
31	5	5	11
32	6	6	17
33	5	5	22
34	8	8	30
35	15	15	45
36	5	5	50
37	7	7	57
38	12	12	69
39	9	9	78
40	6	6	84
41	8	8	92
42	3	3	95
43	3	3	98
44	0	0	98
45	1	1	99
46	1	1	100
47	0	0	100
48	0	0	100
49	0	0	100
50	0	0	100
51	0	0	100
52	0	0	100
53	0	0	100
54	0	0	100
55	0	0	100
56	0	0	100
57	0	0	100
58	0	0	100
59	0	0	100
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62	0	0	100
63	0	0	100
64	0	0	100
65	0	0	100



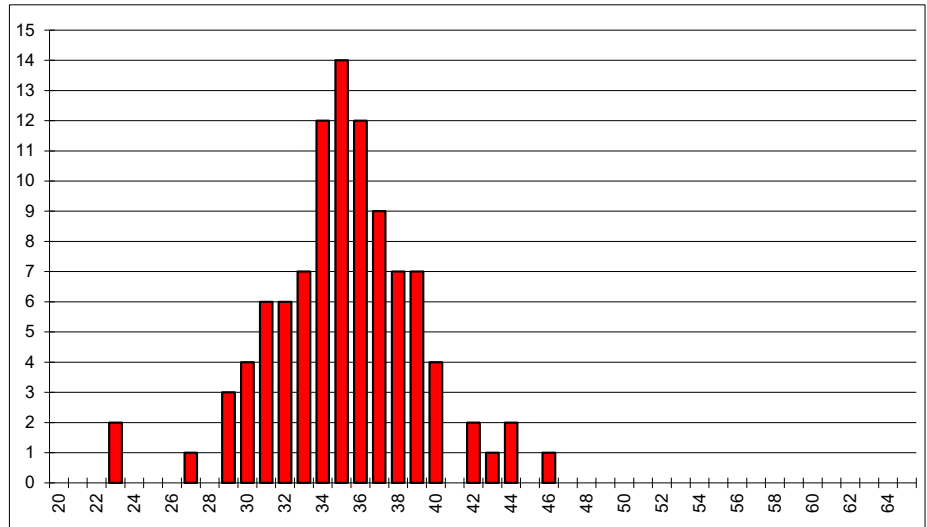
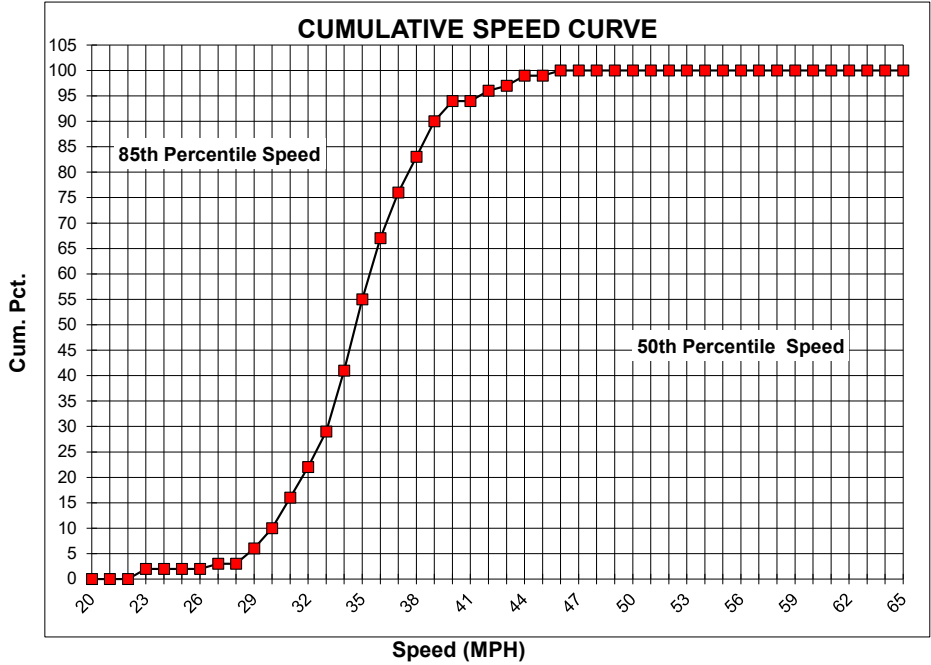
VEHICLE SPEED SURVEY SHEET

STATE OF CALIFORNIA
 BUSINESS, TRANSPORTATION AND HOUSING AGENCY
 DEPARTMENT OF TRANSPORTATION
 CALTRANS DISTRICT 7
 OFFICE OF TRAFFIC MANAGEMENT

LOCATION: **SB PCH at 11th St.**
 P.M.: **22.841**
 DIRECTION(S): **SB** ROUTE: **1**
 DATE: **2/17/2021** TIME: **11:17 AM**
 POSTED SPEED LIMITS: **35** OBSERVER: **AM, WH**
 WEATHER: **Clear and sunny**

50th Percentile Speed	35.0	10 MPH Pace Speed	30 to 39
85th Percentile Speed	39.0	Percent in Pace Speed	84
Number of Vehicles Observed	100	Percent over Pace Speed	10
Average Speed	35	Percent under Pace Speed	6
Range of Speeds	23 to 46		

Speed (MPH)	NO. (cars)	Pct. (%)	Cum. Pct. (%)
20	0	0	0
21	0	0	0
22	0	0	0
23	2	2	2
24	0	0	2
25	0	0	2
26	0	0	2
27	1	1	3
28	0	0	3
29	3	3	6
30	4	4	10
31	6	6	16
32	6	6	22
33	7	7	29
34	12	12	41
35	14	14	55
36	12	12	67
37	9	9	76
38	7	7	83
39	7	7	90
40	4	4	94
41	0	0	94
42	2	2	96
43	1	1	97
44	2	2	99
45	0	0	99
46	1	1	100
47	0	0	100
48	0	0	100
49	0	0	100
50	0	0	100
51	0	0	100
52	0	0	100
53	0	0	100
54	0	0	100
55	0	0	100
56	0	0	100
57	0	0	100
58	0	0	100
59	0	0	100
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62	0	0	100
63	0	0	100
64	0	0	100
65	0	0	100



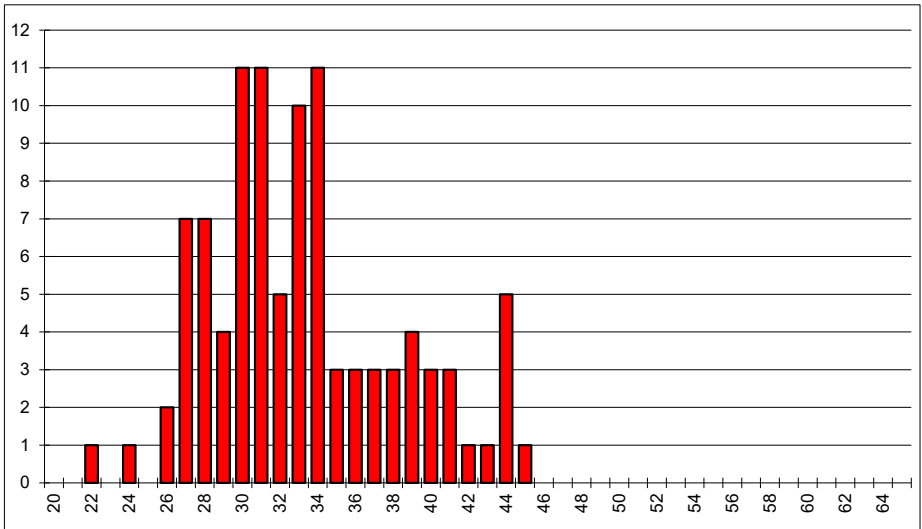
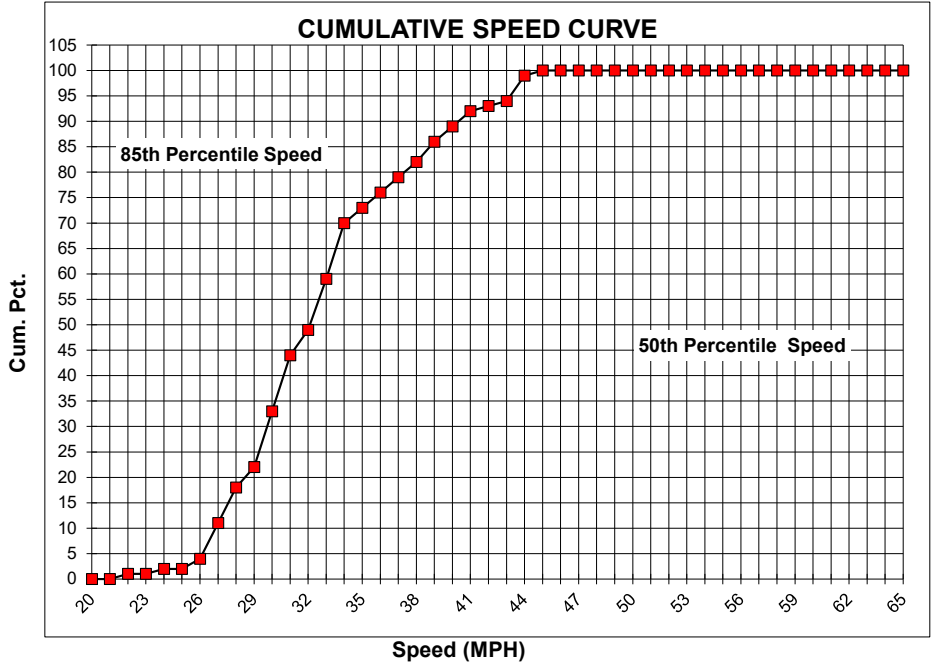
VEHICLE SPEED SURVEY SHEET

STATE OF CALIFORNIA
 BUSINESS, TRANSPORTATION AND HOUSING AGENCY
 DEPARTMENT OF TRANSPORTATION
 CALTRANS DISTRICT 7
 OFFICE OF TRAFFIC MANAGEMENT

LOCATION: **NB PCH between 18th and 22nd**
 P.M.: **23.231**
 DIRECTION(S): **NB** ROUTE: **1**
 DATE: **2/19/2021** TIME: **10:03 AM**
 POSTED SPEED LIMITS: **35** OBSERVER: **AM, WH**
 WEATHER: **Clear and sunny**

50th Percentile Speed	33.0	10 MPH Pace Speed	27 to 36
85th Percentile Speed	39.0	Percent in Pace Speed	72
Number of Vehicles Observed	100	Percent over Pace Speed	24
Average Speed	33	Percent under Pace Speed	4
Range of Speeds	22 to 45		

Speed (MPH)	NO. (cars)	Pct. (%)	Cum. Pct. (%)
20	0	0	0
21	0	0	0
22	1	1	1
23	0	0	1
24	1	1	2
25	0	0	2
26	2	2	4
27	7	7	11
28	7	7	18
29	4	4	22
30	11	11	33
31	11	11	44
32	5	5	49
33	10	10	59
34	11	11	70
35	3	3	73
36	3	3	76
37	3	3	79
38	3	3	82
39	4	4	86
40	3	3	89
41	3	3	92
42	1	1	93
43	1	1	94
44	5	5	99
45	1	1	100
46	0	0	100
47	0	0	100
48	0	0	100
49	0	0	100
50	0	0	100
51	0	0	100
52	0	0	100
53	0	0	100
54	0	0	100
55	0	0	100
56	0	0	100
57	0	0	100
58	0	0	100
59	0	0	100
60	0	0	100
61	0	0	100
62	0	0	100
63	0	0	100
64	0	0	100
65	0	0	100



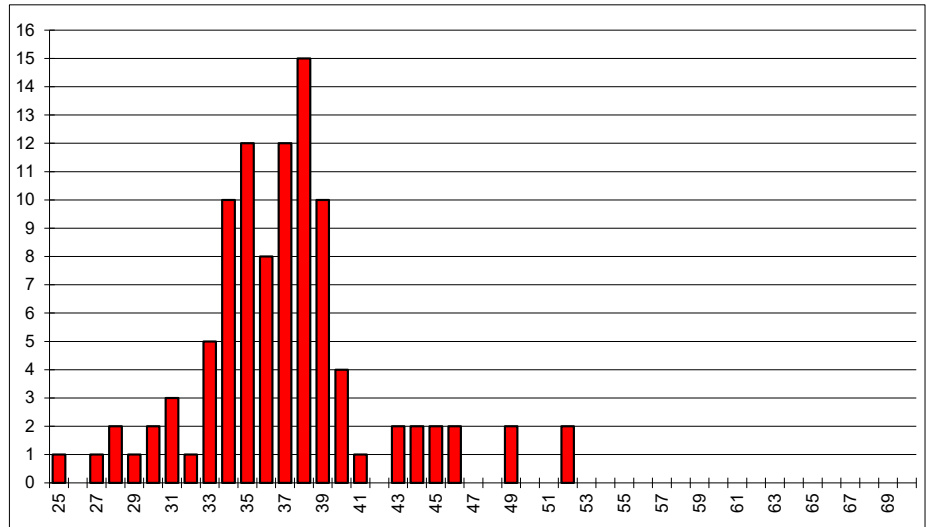
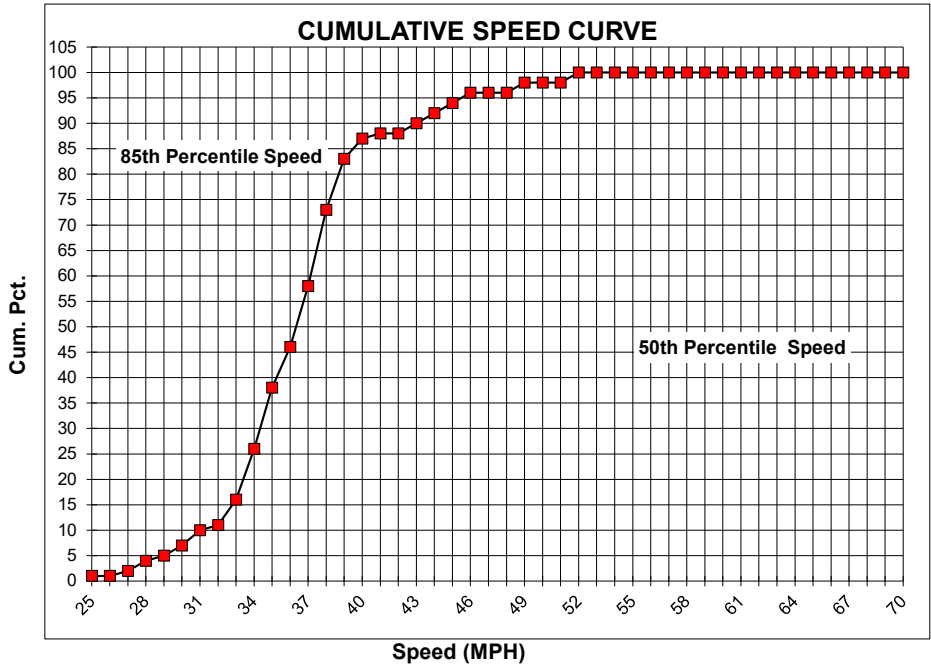
VEHICLE SPEED SURVEY SHEET

STATE OF CALIFORNIA
 BUSINESS, TRANSPORTATION AND HOUSING AGENCY
 DEPARTMENT OF TRANSPORTATION
 CALTRANS DISTRICT 7
 OFFICE OF TRAFFIC MANAGEMENT

LOCATION: **NB PCH between 18th and 22nd**
 P.M.: **23.231**
 DIRECTION(S): **SB** ROUTE: **1**
 DATE: **2/19/2021** TIME: **9:50 AM**
 POSTED SPEED LIMITS: **35** OBSERVER: **AM, WH**
 WEATHER: **Clear and sunny**

50th Percentile Speed	37.0	10 MPH Pace Speed	31 to 40
85th Percentile Speed	40.0	Percent in Pace Speed	80
Number of Vehicles Observed	100	Percent over Pace Speed	13
Average Speed	37	Percent under Pace Speed	7
Range of Speeds	25 to 52		

Speed (MPH)	NO. (cars)	Pct. (%)	Cum. Pct. (%)
25	1	1	1
26	0	0	1
27	1	1	2
28	2	2	4
29	1	1	5
30	2	2	7
31	3	3	10
32	1	1	11
33	5	5	16
34	10	10	26
35	12	12	38
36	8	8	46
37	12	12	58
38	15	15	73
39	10	10	83
40	4	4	87
41	1	1	88
42	0	0	88
43	2	2	90
44	2	2	92
45	2	2	94
46	2	2	96
47	0	0	96
48	0	0	96
49	2	2	98
50	0	0	98
51	0	0	98
52	2	2	100
53	0	0	100
54	0	0	100
55	0	0	100
56	0	0	100
57	0	0	100
58	0	0	100
59	0	0	100
60	0	0	100
61	0	0	100
62	0	0	100
63	0	0	100
64	0	0	100
65	0	0	100
66	0	0	100
67	0	0	100
68	0	0	100
69	0	0	100
70	0	0	100



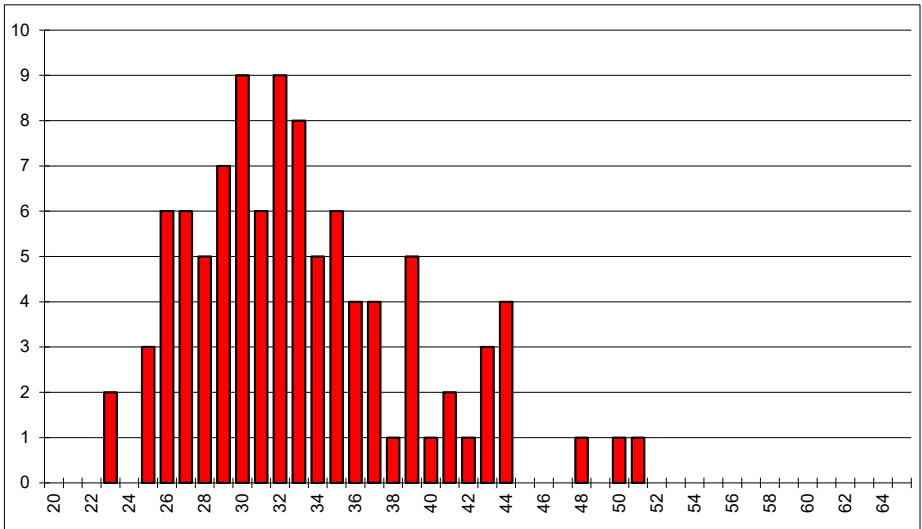
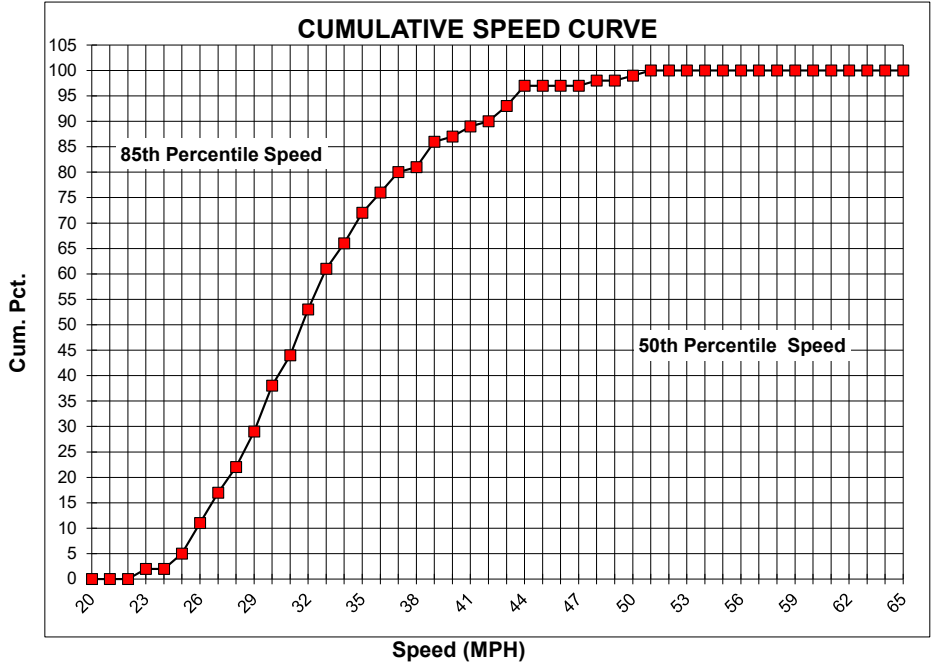
VEHICLE SPEED SURVEY SHEET

STATE OF CALIFORNIA
 BUSINESS, TRANSPORTATION AND HOUSING AGENCY
 DEPARTMENT OF TRANSPORTATION
 CALTRANS DISTRICT 7
 OFFICE OF TRAFFIC MANAGEMENT

LOCATION: **NB PCH south of Rosecrans**
 P.M.: **23.924**
 DIRECTION(S): **NB** ROUTE: **1**
 DATE: **2/19/2021** TIME: **10:37 AM**
 POSTED SPEED LIMITS: **35** OBSERVER: **AM, WH**
 WEATHER: **Clear and sunny**

50th Percentile Speed	32.0	10 MPH Pace Speed	26 to 35
85th Percentile Speed	39.0	Percent in Pace Speed	67
Number of Vehicles Observed	100	Percent over Pace Speed	28
Average Speed	33	Percent under Pace Speed	5
Range of Speeds	23 to 51		

Speed (MPH)	NO. (cars)	Pct. (%)	Cum. Pct. (%)
20	0	0	0
21	0	0	0
22	0	0	0
23	2	2	2
24	0	0	2
25	3	3	5
26	6	6	11
27	6	6	17
28	5	5	22
29	7	7	29
30	9	9	38
31	6	6	44
32	9	9	53
33	8	8	61
34	5	5	66
35	6	6	72
36	4	4	76
37	4	4	80
38	1	1	81
39	5	5	86
40	1	1	87
41	2	2	89
42	1	1	90
43	3	3	93
44	4	4	97
45	0	0	97
46	0	0	97
47	0	0	97
48	1	1	98
49	0	0	98
50	1	1	99
51	1	1	100
52	0	0	100
53	0	0	100
54	0	0	100
55	0	0	100
56	0	0	100
57	0	0	100
58	0	0	100
59	0	0	100
60	0	0	100
61	0	0	100
62	0	0	100
63	0	0	100
64	0	0	100
65	0	0	100



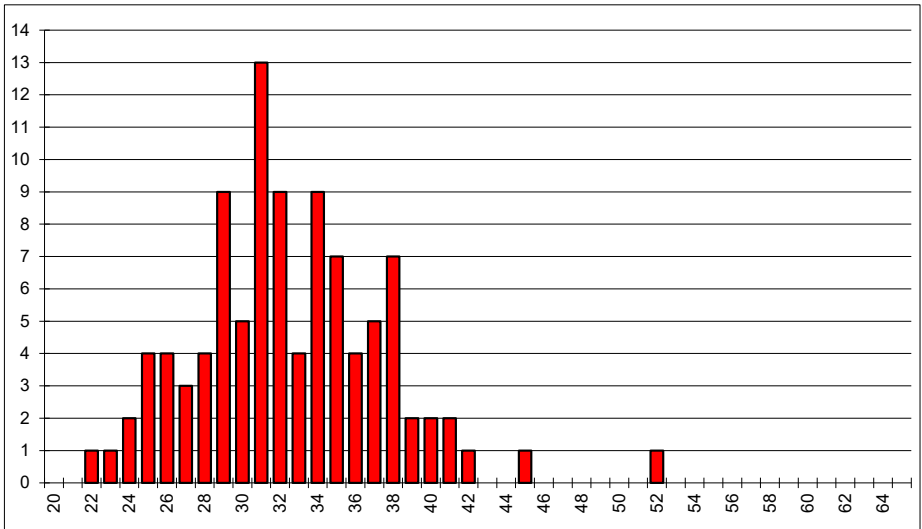
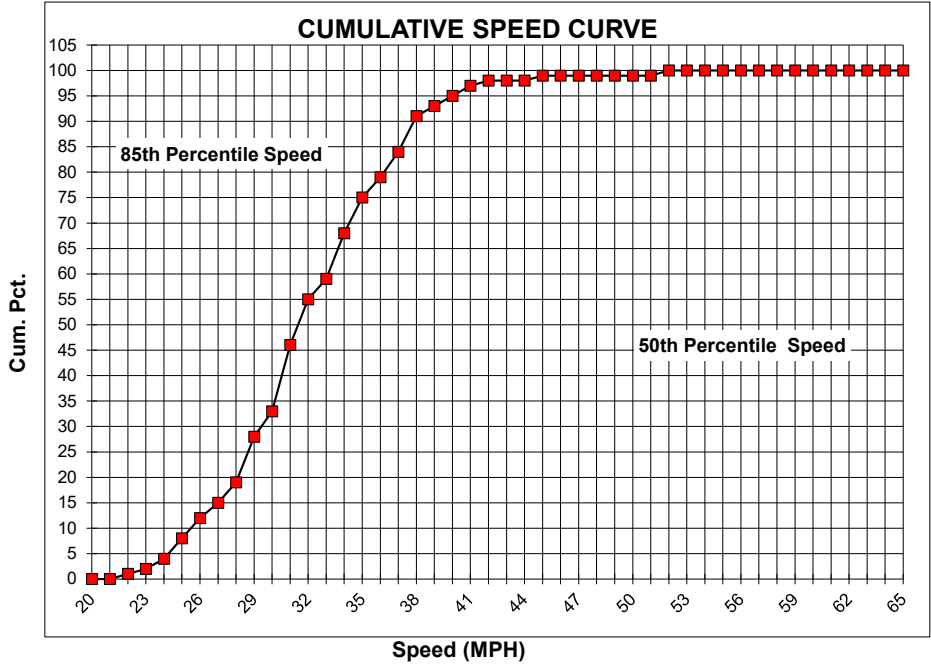
VEHICLE SPEED SURVEY SHEET

STATE OF CALIFORNIA
 BUSINESS, TRANSPORTATION AND HOUSING AGENCY
 DEPARTMENT OF TRANSPORTATION
 CALTRANS DISTRICT 7
 OFFICE OF TRAFFIC MANAGEMENT

LOCATION: **SB PCH south of Rosecrans**
 P.M.: **23.924**
 DIRECTION(S): **SB** ROUTE: **1**
 DATE: **2/19/2021** TIME: **10:20 AM**
 POSTED SPEED LIMITS: **35** OBSERVER: **AM, WH**
 WEATHER: **Clear and sunny**

50th Percentile Speed	32.0	10 MPH Pace Speed	29 to 38
85th Percentile Speed	38.0	Percent in Pace Speed	72
Number of Vehicles Observed	100	Percent over Pace Speed	9
Average Speed	32	Percent under Pace Speed	19
Range of Speeds	22 to 52		

Speed (MPH)	NO. (cars)	Pct. (%)	Cum. Pct. (%)
20	0	0	0
21	0	0	0
22	1	1	1
23	1	1	2
24	2	2	4
25	4	4	8
26	4	4	12
27	3	3	15
28	4	4	19
29	9	9	28
30	5	5	33
31	13	13	46
32	9	9	55
33	4	4	59
34	9	9	68
35	7	7	75
36	4	4	79
37	5	5	84
38	7	7	91
39	2	2	93
40	2	2	95
41	2	2	97
42	1	1	98
43	0	0	98
44	0	0	98
45	1	1	99
46	0	0	99
47	0	0	99
48	0	0	99
49	0	0	99
50	0	0	99
51	0	0	99
52	1	1	100
53	0	0	100
54	0	0	100
55	0	0	100
56	0	0	100
57	0	0	100
58	0	0	100
59	0	0	100
60	0	0	100
61	0	0	100
62	0	0	100
63	0	0	100
64	0	0	100
65	0	0	100



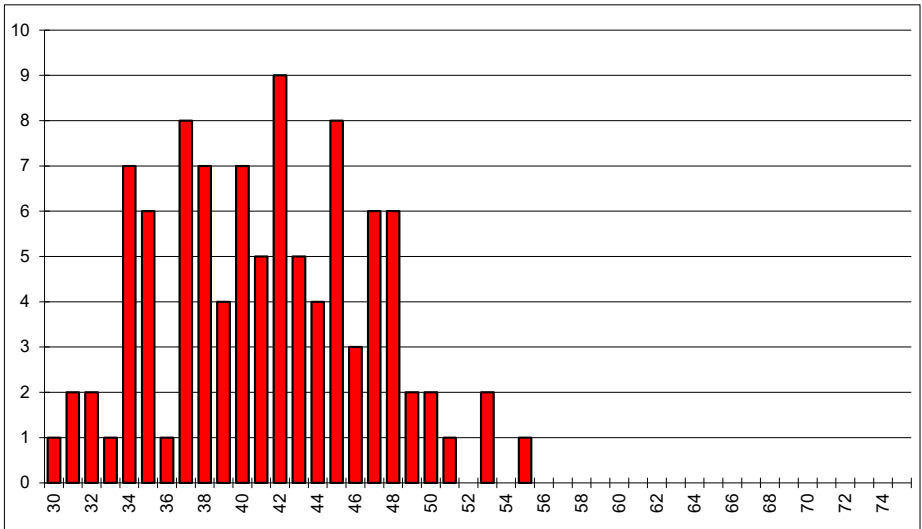
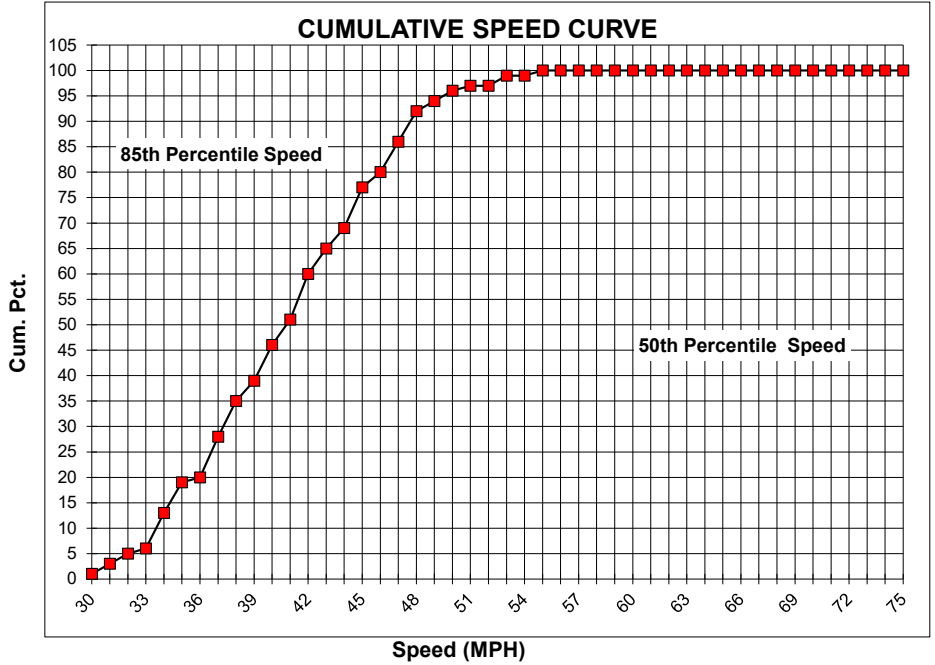
VEHICLE SPEED SURVEY SHEET

STATE OF CALIFORNIA
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 DEPARTMENT OF TRANSPORTATION
 CALTRANS DISTRICT 7
 OFFICE OF TRAFFIC MANAGEMENT

LOCATION: **SB PCH south of El-Segundo**
 P.M.: **24.911**
 DIRECTION(S): **NB** ROUTE: **1**
 DATE: **2/19/2021** TIME: **11:27 AM**
 POSTED SPEED LIMITS: **45** OBSERVER: **AM, WH**
 WEATHER: **Clear and sunny**

50th Percentile Speed	41.0	10 MPH Pace Speed	37 to 46
85th Percentile Speed	47.0	Percent in Pace Speed	60
Number of Vehicles Observed	100	Percent over Pace Speed	20
Average Speed	41	Percent under Pace Speed	20
Range of Speeds	30 to 55		

Speed (MPH)	NO. (cars)	Pct. (%)	Cum. Pct. (%)
30	1	1	1
31	2	2	3
32	2	2	5
33	1	1	6
34	7	7	13
35	6	6	19
36	1	1	20
37	8	8	28
38	7	7	35
39	4	4	39
40	7	7	46
41	5	5	51
42	9	9	60
43	5	5	65
44	4	4	69
45	8	8	77
46	3	3	80
47	6	6	86
48	6	6	92
49	2	2	94
50	2	2	96
51	1	1	97
52	0	0	97
53	2	2	99
54	0	0	99
55	1	1	100
56	0	0	100
57	0	0	100
58	0	0	100
59	0	0	100
60	0	0	100
61	0	0	100
62	0	0	100
63	0	0	100
64	0	0	100
65	0	0	100
66	0	0	100
67	0	0	100
68	0	0	100
69	0	0	100
70	0	0	100
71	0	0	100
72	0	0	100
73	0	0	100
74	0	0	100
75	0	0	100



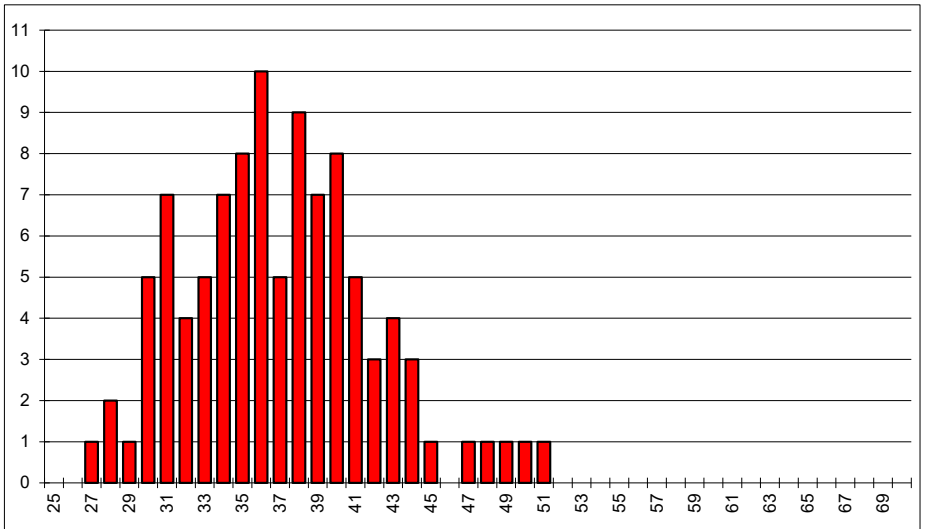
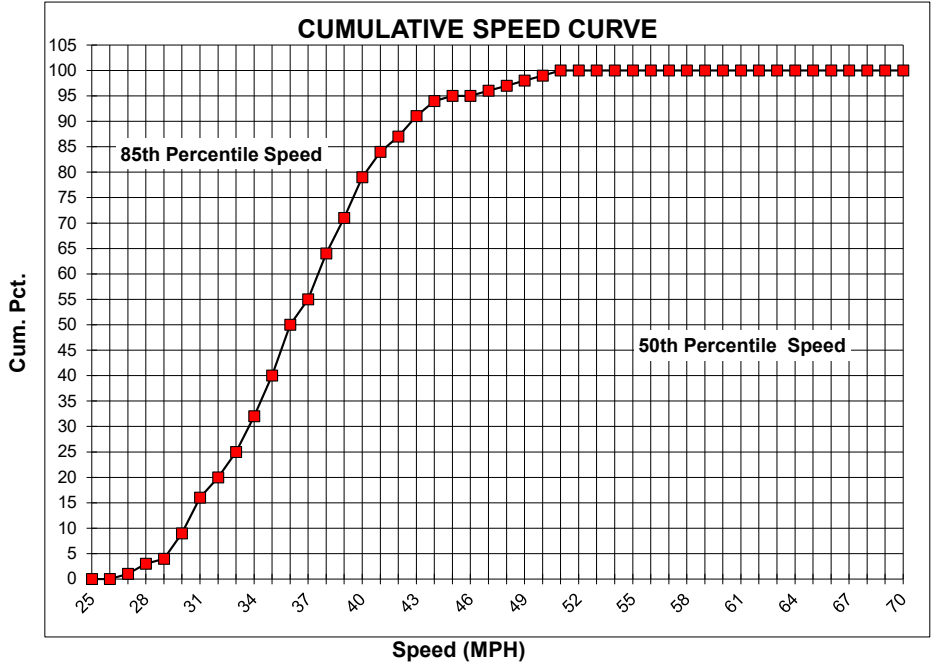
VEHICLE SPEED SURVEY SHEET

STATE OF CALIFORNIA
 BUSINESS, TRANSPORTATION AND HOUSING AGENCY
 DEPARTMENT OF TRANSPORTATION
 CALTRANS DISTRICT 7
 OFFICE OF TRAFFIC MANAGEMENT

LOCATION: **SB PCH south of El-Segundo**
 P.M.: **24.911**
 DIRECTION(S): **SB** ROUTE: **1**
 DATE: **2/19/2021** TIME: **11:22 AM**
 POSTED SPEED LIMITS: **45** OBSERVER: **AM, WH**
 WEATHER: **Clear and sunny**

50th Percentile Speed	36.0	10 MPH Pace Speed	31 to 40
85th Percentile Speed	42.0	Percent in Pace Speed	70
Number of Vehicles Observed	100	Percent over Pace Speed	21
Average Speed	37	Percent under Pace Speed	9
Range of Speeds	27 to 51		

Speed (MPH)	NO. (cars)	Pct. (%)	Cum. Pct. (%)
25	0	0	0
26	0	0	0
27	1	1	1
28	2	2	3
29	1	1	4
30	5	5	9
31	7	7	16
32	4	4	20
33	5	5	25
34	7	7	32
35	8	8	40
36	10	10	50
37	5	5	55
38	9	9	64
39	7	7	71
40	8	8	79
41	5	5	84
42	3	3	87
43	4	4	91
44	3	3	94
45	1	1	95
46	0	0	95
47	1	1	96
48	1	1	97
49	1	1	98
50	1	1	99
51	1	1	100
52	0	0	100
53	0	0	100
54	0	0	100
55	0	0	100
56	0	0	100
57	0	0	100
58	0	0	100
59	0	0	100
60	0	0	100
61	0	0	100
62	0	0	100
63	0	0	100
64	0	0	100
65	0	0	100
66	0	0	100
67	0	0	100
68	0	0	100
69	0	0	100
70	0	0	100



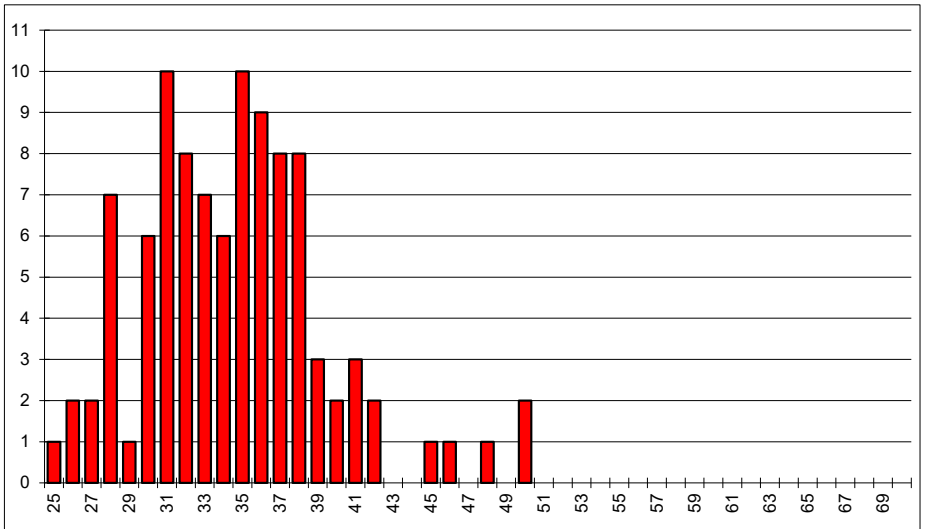
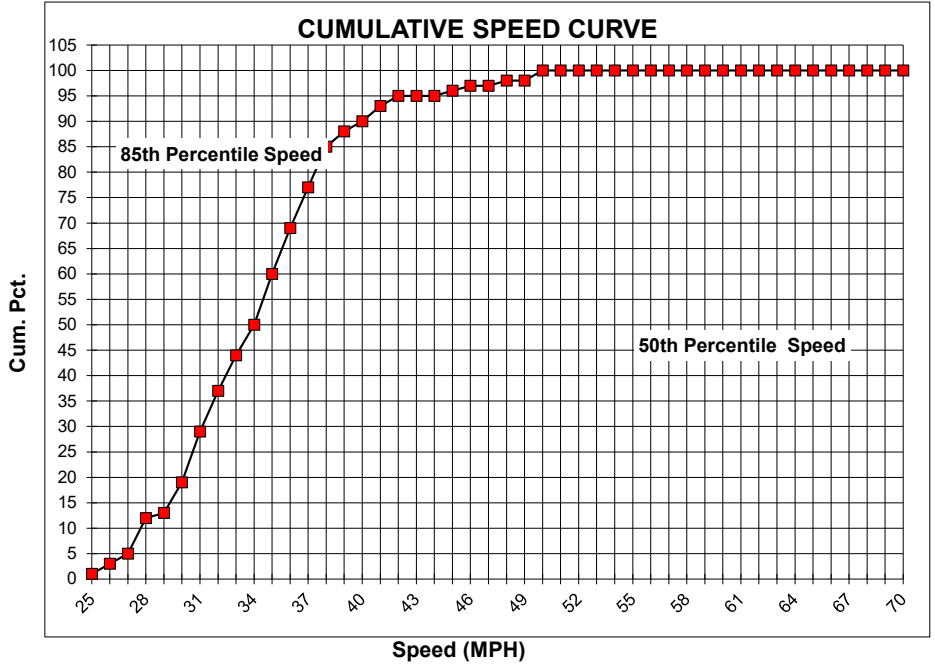
VEHICLE SPEED SURVEY SHEET

STATE OF CALIFORNIA
 BUSINESS, TRANSPORTATION AND HOUSING AGENCY
 DEPARTMENT OF TRANSPORTATION
 CALTRANS DISTRICT 7
 OFFICE OF TRAFFIC MANAGEMENT

LOCATION: **north of Mariposa Ave**
 P.M.: **25.441**
 DIRECTION(S): **NB** ROUTE: **1**
 DATE: **2/22/2021** TIME: **10:05 AM**
 POSTED SPEED LIMITS: **40** OBSERVER: **AM, WH**
 WEATHER: **Clear and sunny**

50th Percentile Speed	34.0	10 MPH Pace Speed	30 to 39
85th Percentile Speed	38.0	Percent in Pace Speed	75
Number of Vehicles Observed	100	Percent over Pace Speed	12
Average Speed	35	Percent under Pace Speed	13
Range of Speeds	25 to 50		

Speed (MPH)	NO. (cars)	Pct. (%)	Cum. Pct. (%)
25	1	1	1
26	2	2	3
27	2	2	5
28	7	7	12
29	1	1	13
30	6	6	19
31	10	10	29
32	8	8	37
33	7	7	44
34	6	6	50
35	10	10	60
36	9	9	69
37	8	8	77
38	8	8	85
39	3	3	88
40	2	2	90
41	3	3	93
42	2	2	95
43	0	0	95
44	0	0	95
45	1	1	96
46	1	1	97
47	0	0	97
48	1	1	98
49	0	0	98
50	2	2	100
51	0	0	100
52	0	0	100
53	0	0	100
54	0	0	100
55	0	0	100
56	0	0	100
57	0	0	100
58	0	0	100
59	0	0	100
60	0	0	100
61	0	0	100
62	0	0	100
63	0	0	100
64	0	0	100
65	0	0	100
66	0	0	100
67	0	0	100
68	0	0	100
69	0	0	100
70	0	0	100



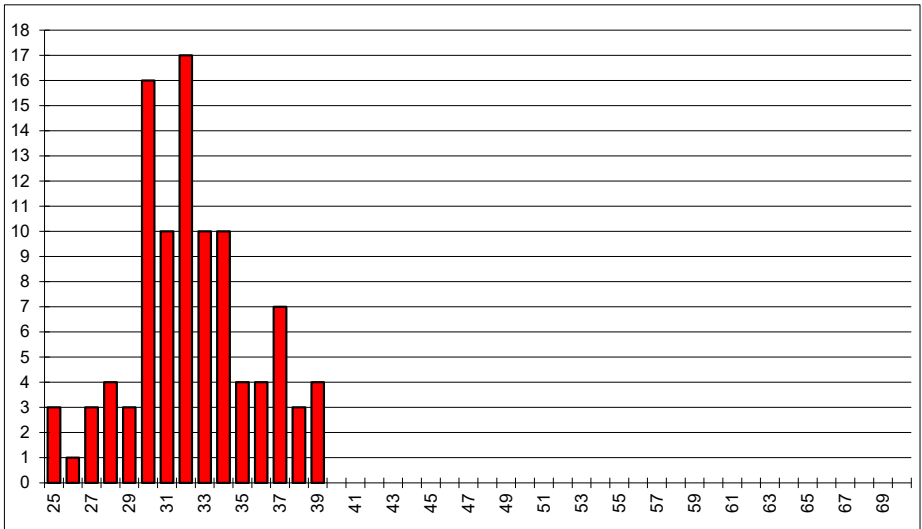
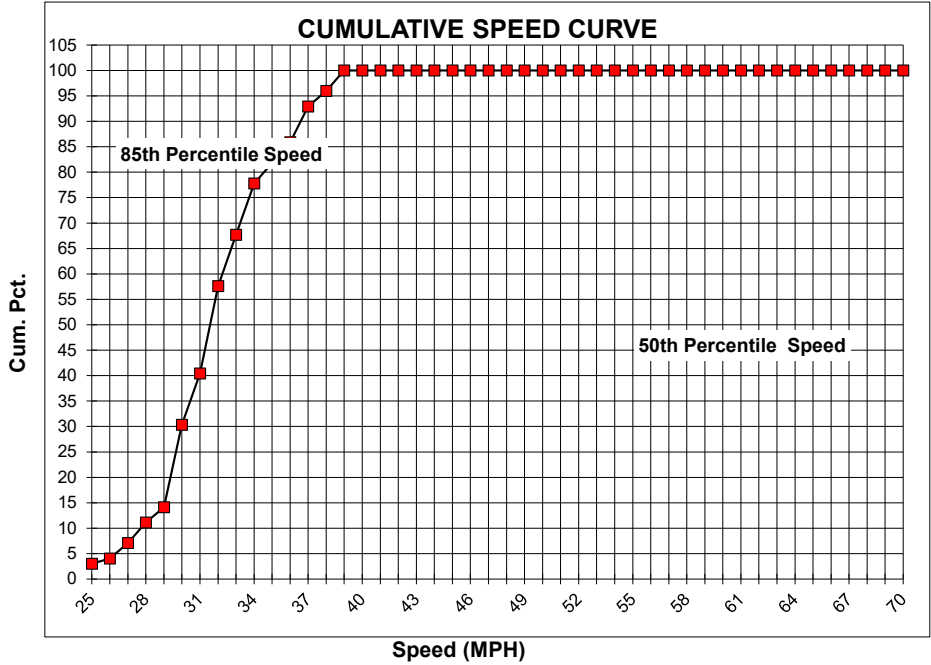
VEHICLE SPEED SURVEY SHEET

STATE OF CALIFORNIA
 BUSINESS, TRANSPORTATION AND HOUSING AGENCY
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 CALTRANS DISTRICT 7
 OFFICE OF TRAFFIC MANAGEMENT

LOCATION: **north of Mariposa Ave**
 P.M.: **25.441**
 DIRECTION(S): **SB** ROUTE: **1**
 DATE: **2/22/2021** TIME: **10:15 AM**
 POSTED SPEED LIMITS: **40** OBSERVER: **AM, WH**
 WEATHER: **Clear and sunny**

50th Percentile Speed	32.0	10 MPH Pace Speed	28 to 37
85th Percentile Speed	36.0	Percent in Pace Speed	86
Number of Vehicles Observed	99	Percent over Pace Speed	7
Average Speed	32	Percent under Pace Speed	7
Range of Speeds	25 to 39		

Speed (MPH)	NO. (cars)	Pct. (%)	Cum. Pct. (%)
25	3	3	3
26	1	1	4
27	3	3	7
28	4	4	11
29	3	3	14
30	16	16	30
31	10	10	40
32	17	17	58
33	10	10	68
34	10	10	78
35	4	4	82
36	4	4	86
37	7	7	93
38	3	3	96
39	4	4	100
40	0	0	100
41	0	0	100
42	0	0	100
43	0	0	100
44	0	0	100
45	0	0	100
46	0	0	100
47	0	0	100
48	0	0	100
49	0	0	100
50	0	0	100
51	0	0	100
52	0	0	100
53	0	0	100
54	0	0	100
55	0	0	100
56	0	0	100
57	0	0	100
58	0	0	100
59	0	0	100
60	0	0	100
61	0	0	100
62	0	0	100
63	0	0	100
64	0	0	100
65	0	0	100
66	0	0	100
67	0	0	100
68	0	0	100
69	0	0	100
70	0	0	100



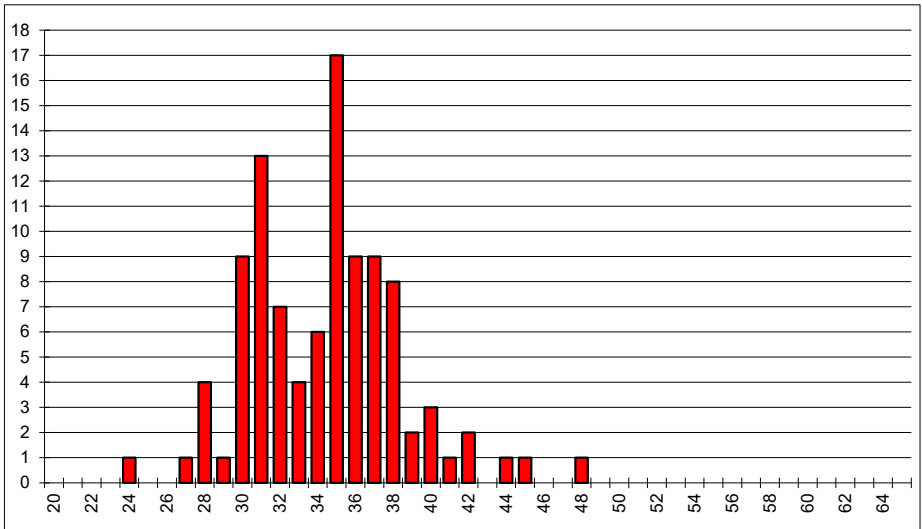
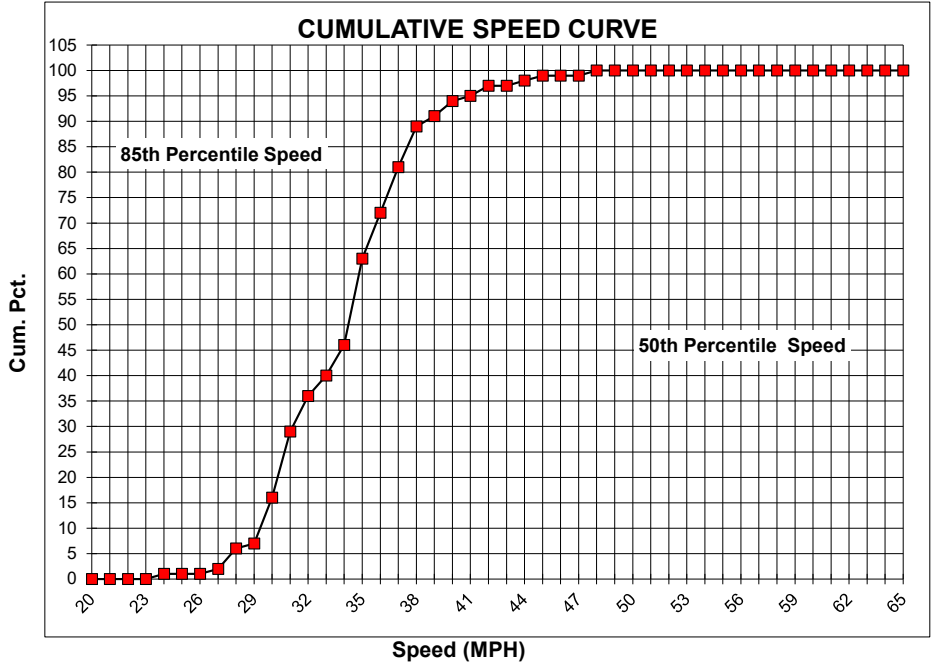
VEHICLE SPEED SURVEY SHEET

STATE OF CALIFORNIA
 BUSINESS, TRANSPORTATION AND HOUSING AGENCY
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 CALTRANS DISTRICT 7
 OFFICE OF TRAFFIC MANAGEMENT

LOCATION: **South of Imperial Hwy**
 P.M.: **25.921**
 DIRECTION(S): **NB** ROUTE: **1**
 DATE: **2/22/2021** TIME: **10:45 AM**
 POSTED SPEED LIMITS: **40** OBSERVER: **AM, WH**
 WEATHER: **Clear and sunny**

50th Percentile Speed	35.0	10 MPH Pace Speed	30 to 39
85th Percentile Speed	38.0	Percent in Pace Speed	84
Number of Vehicles Observed	100	Percent over Pace Speed	9
Average Speed	34	Percent under Pace Speed	7
Range of Speeds	24 to 48		

Speed (MPH)	NO. (cars)	Pct. (%)	Cum. Pct. (%)
20	0	0	0
21	0	0	0
22	0	0	0
23	0	0	0
24	1	1	1
25	0	0	1
26	0	0	1
27	1	1	2
28	4	4	6
29	1	1	7
30	9	9	16
31	13	13	29
32	7	7	36
33	4	4	40
34	6	6	46
35	17	17	63
36	9	9	72
37	9	9	81
38	8	8	89
39	2	2	91
40	3	3	94
41	1	1	95
42	2	2	97
43	0	0	97
44	1	1	98
45	1	1	99
46	0	0	99
47	0	0	99
48	1	1	100
49	0	0	100
50	0	0	100
51	0	0	100
52	0	0	100
53	0	0	100
54	0	0	100
55	0	0	100
56	0	0	100
57	0	0	100
58	0	0	100
59	0	0	100
60	0	0	100
61	0	0	100
62	0	0	100
63	0	0	100
64	0	0	100
65	0	0	100



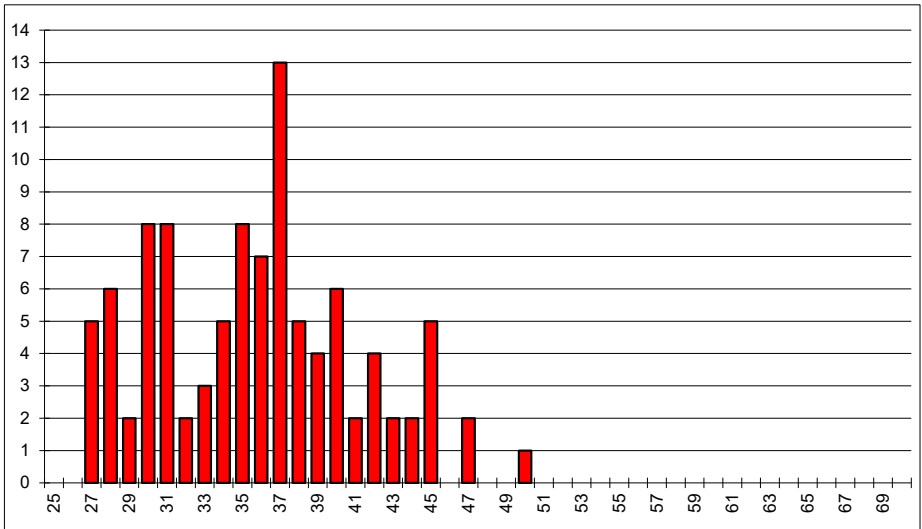
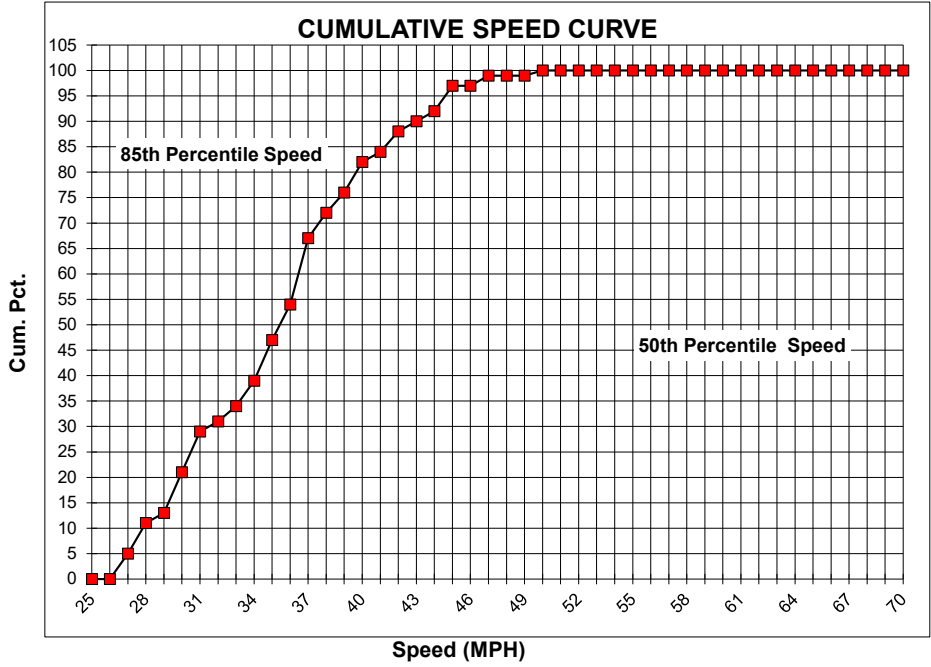
VEHICLE SPEED SURVEY SHEET

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 CALTRANS DISTRICT 7
 OFFICE OF TRAFFIC MANAGEMENT

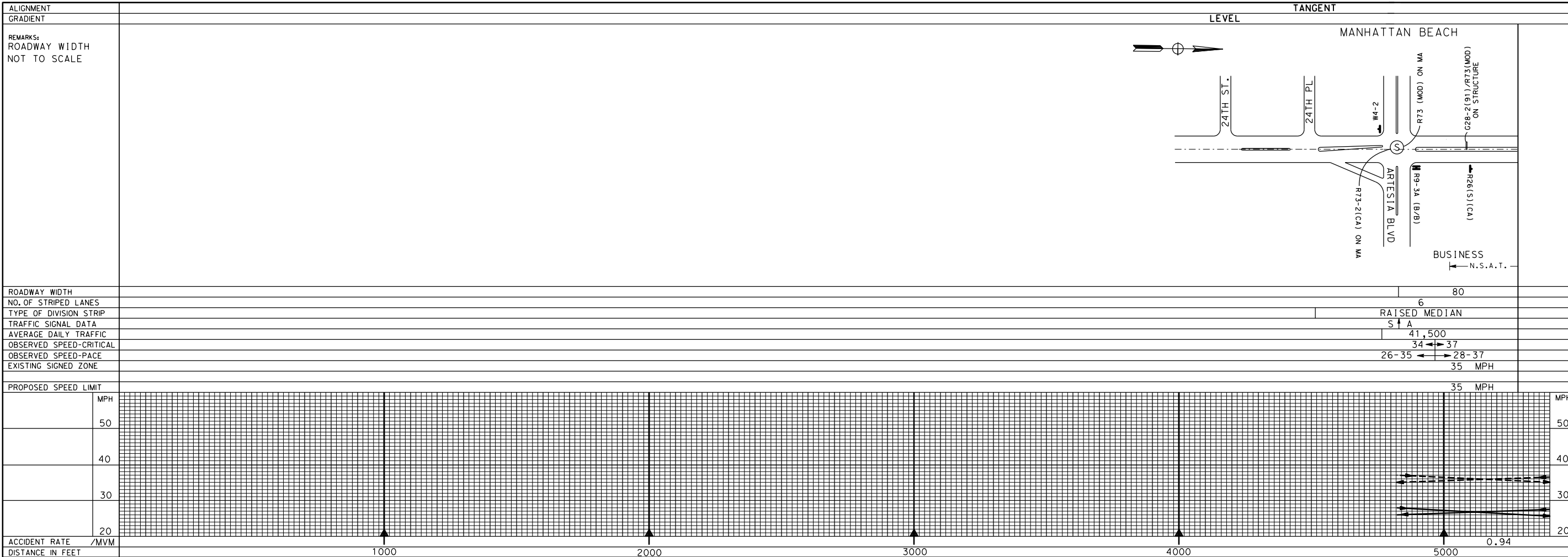
LOCATION: **South of Imperial Hwy**
 P.M.: **25.921**
 DIRECTION(S): **SB** ROUTE: **1**
 DATE: **2/22/2021** TIME: **10:34 AM**
 POSTED SPEED LIMITS: **40** OBSERVER: **AM, WH**
 WEATHER: **Clear and sunny**

50th Percentile Speed	36.0	10 MPH Pace Speed	30 to 39
85th Percentile Speed	42.0	Percent in Pace Speed	63
Number of Vehicles Observed	100	Percent over Pace Speed	24
Average Speed	36	Percent under Pace Speed	13
Range of Speeds	27 to 50		

Speed (MPH)	NO. (cars)	Pct. (%)	Cum. Pct. (%)
25	0	0	0
26	0	0	0
27	5	5	5
28	6	6	11
29	2	2	13
30	8	8	21
31	8	8	29
32	2	2	31
33	3	3	34
34	5	5	39
35	8	8	47
36	7	7	54
37	13	13	67
38	5	5	72
39	4	4	76
40	6	6	82
41	2	2	84
42	4	4	88
43	2	2	90
44	2	2	92
45	5	5	97
46	0	0	97
47	2	2	99
48	0	0	99
49	0	0	99
50	1	1	100
51	0	0	100
52	0	0	100
53	0	0	100
54	0	0	100
55	0	0	100
56	0	0	100
57	0	0	100
58	0	0	100
59	0	0	100
60	0	0	100
61	0	0	100
62	0	0	100
63	0	0	100
64	0	0	100
65	0	0	100
66	0	0	100
67	0	0	100
68	0	0	100
69	0	0	100
70	0	0	100



VEHICLE SPEED SURVEY SHEET



STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
TRAFFIC BRANCH

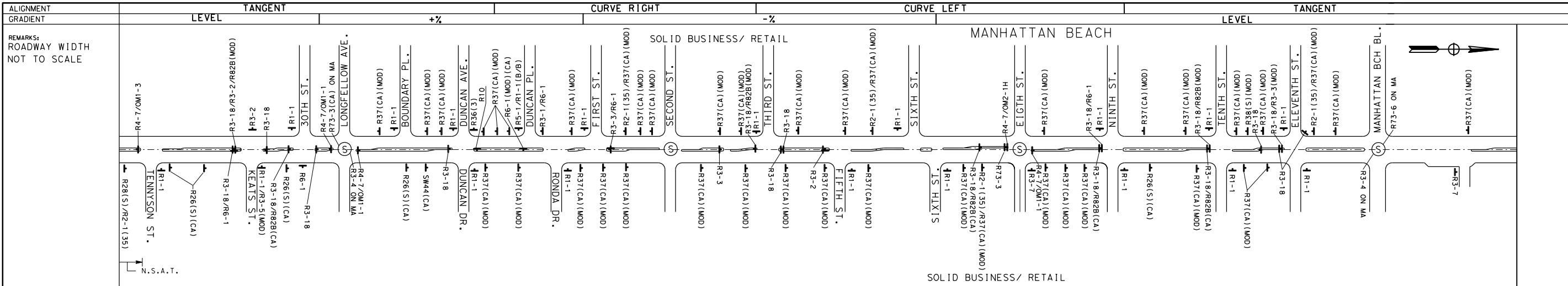
SPEED ZONE SURVEY

DIST. 07 CO. LA RTE. 01 SEC. _____
 CITY OR TOWN MANHATTAN BCH
 STREET OR ROAD SEPULVEDA BLVD
 FROM 21.00 TO 22.00
 SCALE 1"=200'
 DATE APRIL 2023

LEGEND

ROAD SIGNS	REGULATORY & WARNING	CODE NO. ↓
TRAFFIC SIGNALS	(S)	
CRITICAL SPEED	---	
LOWER LIMIT OF PACE	—	
INDICATE		
HOSPITALS, PUBLIC BUILDINGS, AUDITORIUMS, PUBLIC PARKS, SCHOOLS		

1 OF 5



STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
TRAFFIC BRANCH

SPEED ZONE SURVEY

DIST. 07 CO. LA RTE. 001 SEC.

CITY OR TOWN MANHATTAN BCH.

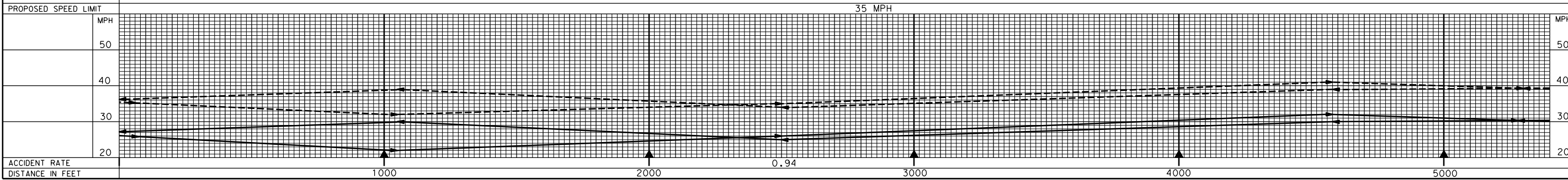
STREET OR ROAD SEPULVEDA BLVD.

FROM 22.00 TO 23.00

SCALE 1"=200'

DATE APRIL 2023

ROADWAY WIDTH	74
NO. OF STRIPED LANES	6
TYPE OF DIVISION STRIP	RAISED MEDIAN
TRAFFIC SIGNAL DATA	SAA SAA SAA FAA
AVERAGE DAILY TRAFFIC	44,000
OBSERVED SPEED-CRITICAL	39 ← 31
OBSERVED SPEED-PACE	30-39 ← 22-31
EXISTING SIGNED ZONE	25-34 ← 26-35
PROPOSED SPEED LIMIT	35 MPH



LEGEND

ROAD SIGNS
REGULATORY & WARNING (CODE NO.)

TRAFFIC SIGNS (S)

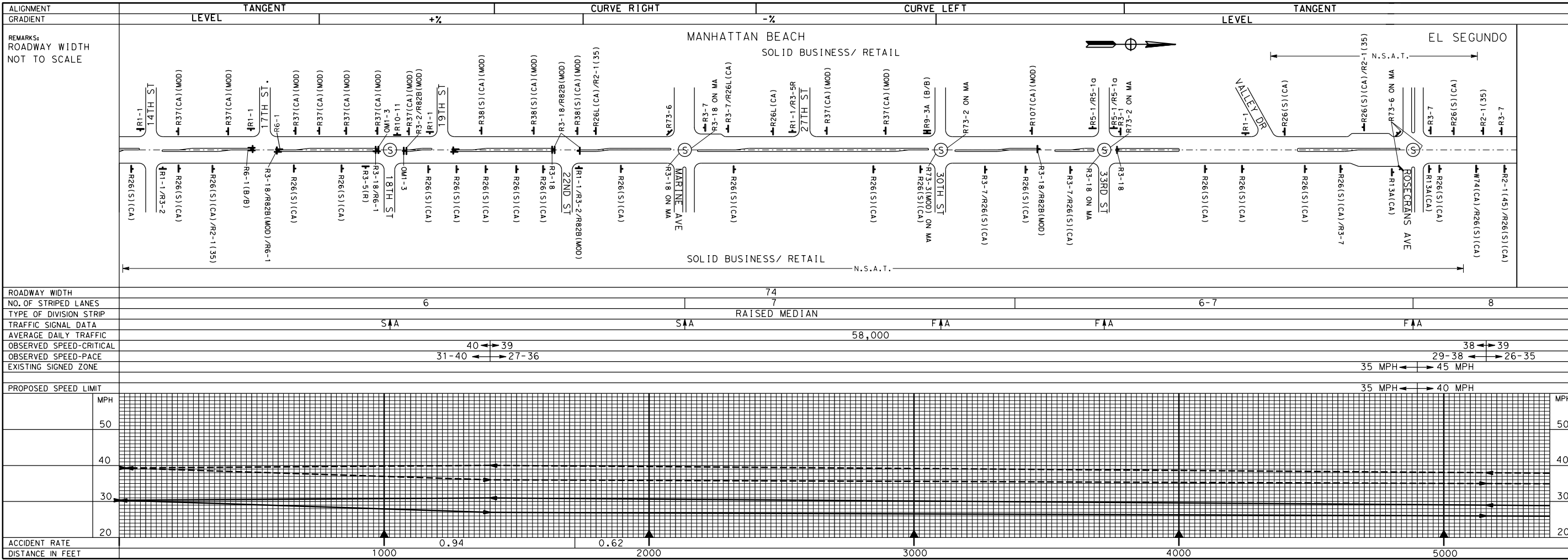
CRITICAL SPEED (---)

LOWER LIMIT OF PACE (—)

INDICATE
HOSPITALS, PUBLIC BUILDINGS,
AUDITORIUMS, PUBLIC PARKS,
SCHOOLS

GREEN — EXISTING ZONES
RED — PROPOSED ZONES

2 OF 5



STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
TRAFFIC BRANCH

SPEED ZONE SURVEY

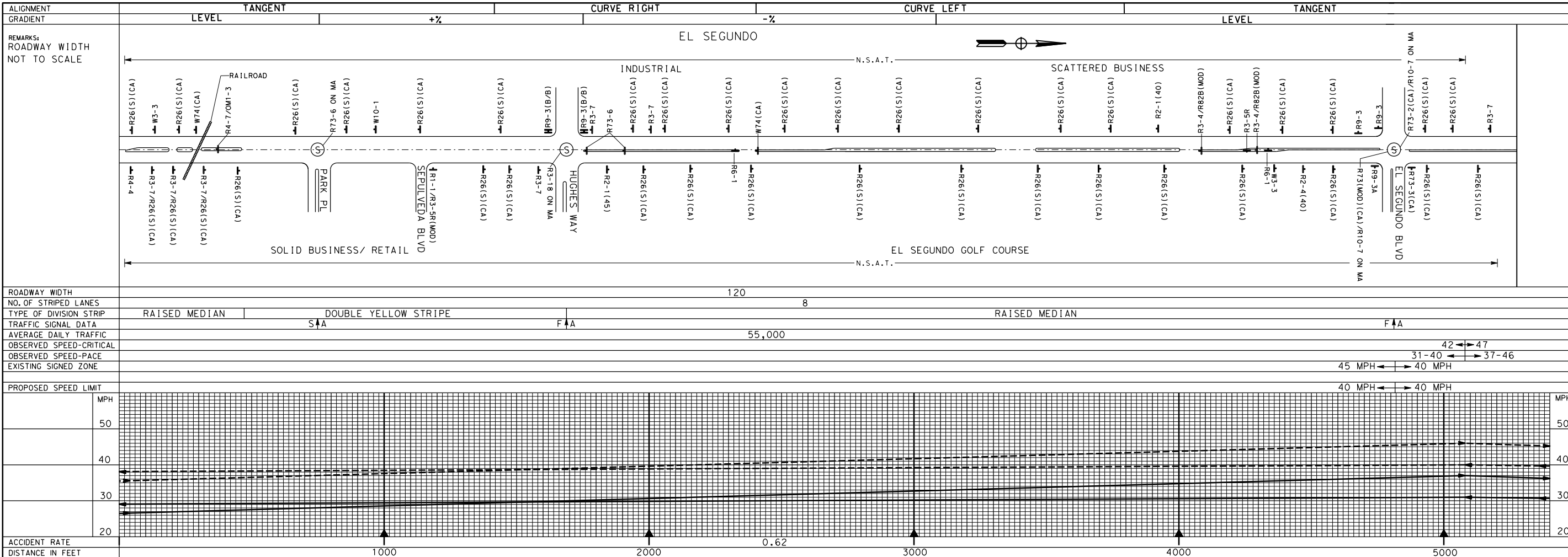
DIST. 07 CO. LA RTE. 01 SEC. _____
 CITY OR TOWN _____
 STREET OR ROAD _____ PCH _____
 FROM 23.00 TO 24.00 _____
 SCALE 1"=200'
 DATE APRIL 2023

LEGEND

ROAD SIGNS	REGULATORY & WARNING	CODE NO. →
TRAFFIC SIGNS		(S)
CRITICAL SPEED		---
LOWER LIMIT OF PACE		---
INDICATE	HOSPITALS, PUBLIC BUILDINGS, AUDITORIUMS, PUBLIC PARKS, SCHOOLS	

3 OF 5

ROADWAY WIDTH	74
NO. OF STRIPED LANES	6
TYPE OF DIVISION STRIP	RAISED MEDIAN
TRAFFIC SIGNAL DATA	SAA
AVERAGE DAILY TRAFFIC	58,000
OBSERVED SPEED-CRITICAL	40 ← 39
OBSERVED SPEED-PACE	31-40 ← 27-36
EXISTING SIGNED ZONE	35 MPH ← 45 MPH
PROPOSED SPEED LIMIT	35 MPH ← 40 MPH
ACCIDENT RATE	0.94
DISTANCE IN FEET	1000



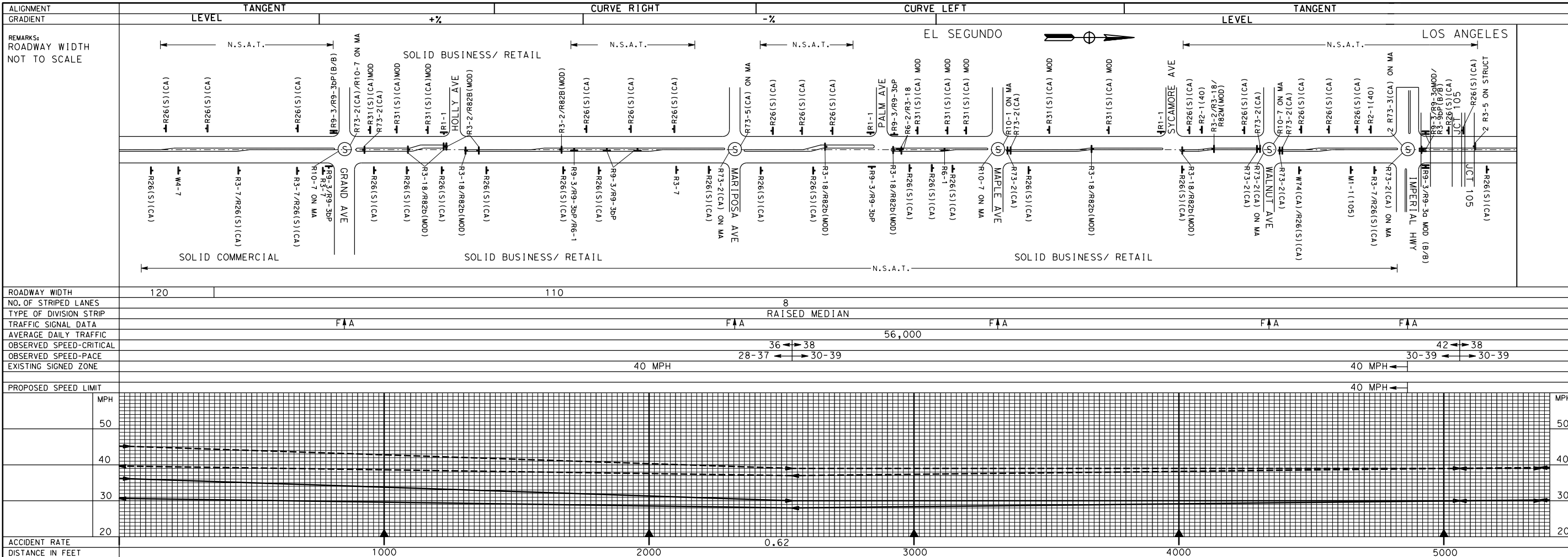
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
TRAFFIC BRANCH

SPEED ZONE SURVEY

DIST. 07 CO. LA RTE. 01 SEC.
CITY OR TOWN _____
STREET OR ROAD PCH
FROM 24.00 TO 25.00
SCALE 1"=200'
DATE APRIL 2023

LEGEND

- ROAD SIGNS
- REGULATORY & WARNING
- TRAFFIC SIGNS
- CRITICAL SPEED
- LOWER LIMIT OF PACE
- INDICATE
- HOSPITALS, PUBLIC BUILDINGS, AUDITORIUMS, PUBLIC PARKS, SCHOOLS



STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
TRAFFIC BRANCH

SPEED ZONE SURVEY

DIST. 07 CO. LA RTE. 01 SEC.
CITY OR TOWN _____
STREET OR ROAD _____ PCH
FROM 25.00 TO 26.00
SCALE 1"=200'
DATE APRIL 2023

LEGEND

- ROAD SIGNS REGULATORY & WARNING (CODE NO.)
- TRAFFIC SIGNS (S)
- CRITICAL SPEED (---)
- LOWER LIMIT OF PACE (—)
- INDICATE HOSPITALS, PUBLIC BUILDINGS, AUDITORIUMS, PUBLIC PARKS, SCHOOLS

STATE PRIORITY SAFETY CORRIDOR INITIATIVE

Launching Oct. 15, 2025, In Conjunction with the Joint Secretary's Policy on Road Safety

OVERVIEW

The State Priority Safety Corridor initiative demonstrates California's renewed commitment to preventing fatal and serious injuries on our roadways. These corridors apply the Safe System Approach, now formally adopted through the Joint Secretary's Policy on Road Safety, into action at the corridor scale. Each corridor is prioritized and supported by data as a high-injury location where State, regional, and local partners will apply the Safe System principles of prevention, shared responsibility, and equity to reduce harm and save lives.

PURPOSE

To institutionalize injury prevention practice into corridor planning, design and operations, creating models for institutionalizing safety statewide.

HOW CORRIDORS IMPLEMENT THE POLICY

Each corridor provides a great opportunity to apply and evaluate the Policy's guiding principles.

EXPECTED OUTCOMES

- Demonstrate how upstream, system-level safety measures deliver measurable reductions in fatalities and serious injuries.
- Develop a framework for corridor-scale Safe System planning and investment that can be used throughout the state and nation.
- Build public trust through transparent collaboration and joint leadership between CalSTA, CalHHS, Caltrans, CHP, OTS, and local partners.
- Achieve a 30% reduction in fatalities and serious injuries by 2035, as part of a longer term goal of zero fatalities and serious injuries by 2050.

WHY IT MATTERS

Together, the Policy and the Corridor Initiative mark a turning point: safety becomes the organizing principle of California's transportation system. These corridors will show how coordinated, prevention-based action, across agencies and communities, creates lasting change on our roads.

POLICY COMMITMENT

Prevention first: Prioritize population level prevention of harm

Safety for all users: Equitable access to safe travel

Institutional alignment: Integrate safety and apply principles across programs, standards and operations

Investment discipline: Direct resources to strategically achieve the highest level of safety and return on investment.

CORRIDOR IMPLEMENTATION

Apply the Safe System hierarchy (exposure, likelihood, severity) to select upstream, system-level strategies rather than rely on individual behavior change

Co-develop actions with community partners and address disproportionate risk for vulnerable road users

Align Caltrans, CHP, OTS, and local actions under one coordinated Safe System implementation effort per corridor

Use corridor data to prioritize and sequence investments that yield the greatest reduction in severe injury risk





MAKING OUR ROADS SAFER

One Countermeasure at a Time

28 Proven Safety Countermeasures that offer significant and measurable impacts to improving safety



U.S. Department of Transportation
Federal Highway Administration

Parking and Public Improvements Commission
 March 26, 2026

ZERO IS OUR GOAL

A SAFE SYSTEM IS HOW WE GET THERE

<https://safety.fhwa.dot.gov/>

Technical Report Documentation Page

1. REPORT NO. FHWA-SA-21-071	2. GOVERNMENT ACCESSION NO.	3. RECIPIENT'S CATALOG NO.	
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		6. PERFORMING ORGANIZATION CODE	
7. AUTHOR(S) Matt Albee, Phillip Bobitz		8. PERFORMING ORGANIZATION REPORT NO.	
9. PERFORMING ORGANIZATION NAME & ADDRESS VHB 940 Main Campus Dr Ste 500 Raleigh, NC 27606		10. WORK UNIT NO.	
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12. SPONSORING AGENCY NAME AND ADDRESS Federal Highway Administration Office of Safety 1200 New Jersey Ave., SE Washington, DC 20590		13. TYPE OF REPORT AND PERIOD Final Report, July 2020 – August 2021	
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15. SUPPLEMENTARY NOTES The Contract Manager for this report was Phillip Bobitz (FHWA Office of Safety). Matt Albee (VHB) was the Principal Investigator. An FHWA Technical Oversight Working Group included: Dick Albin, Usman Ali, Roya Amjadi, RosemarieAnderson, Eduardo Arispe, Tori Brinkly, Joe Cheung, Becky Crowe, Mike Griffith, Ken Kochevar, MichaelMatzke, Tara McLoughlin, Laura Mero, Anyesha Mookherjee, Elliott Moore, Norah Ocel, Tamara Redmon, Jerry Roche, Cate Satterfield, Jeff Shaw, Keith Sinclair, Karen Timpone, Guan Xu, and Abdul Zineddin.			
16. ABSTRACT The Proven Safety Countermeasure Initiative (PSCi) is a collection of 28 countermeasures and strategies effective in reducing roadway fatalities and serious injuries on our Nation's highways. Transportation agencies are strongly encouraged to consider widespread implementation of PSCs to accelerate the achievement of local, State, and National safety goals. This booklet provides 1-page handouts for all 28 PSCs, broken into the focus areas of speed management, roadway departure, intersections, pedestrians/bicyclists, and crosscutting for countermeasures that apply across categories.			
17. KEY WORDS safety, countermeasures, speed management, roadway departure, intersections, pedestrian, bicyclist		18. DISTRIBUTION STATEMENT No restrictions.	
19. SECURITY CLASSIF. (OF THIS REPORT) Unclassified	20. SECURITY CLASSIF. (OF THIS PAGE) Unclassified	21. NO. OF PAGES 33	22. PRICE

Proven Safety Countermeasures

SPEED MANAGEMENT



Speed Safety Cameras



Variable Speed Limits



Appropriate Speed Limits for All Road Users

ROADWAY DEPARTURE



Wider Edge Lines



Enhanced Delineation for Horizontal Curves



Longitudinal Rumble Strips and Stripes on Two-Lane Roads



SafetyEdgeSM



Roadside Design Improvements at Curves



Median Barriers

INTERSECTIONS



Backplates with Retroreflective Borders



Corridor Access Management



Dedicated Left- and Right-Turn Lanes at Intersections



Reduced Left-Turn Conflict Intersections



Roundabouts



Systemic Application of Multiple Low-Cost Countermeasures at Stop-Controlled Intersections



Yellow Change Intervals

PEDESTRIANS/BICYCLES



Crosswalk Visibility Enhancements



Bicycle Lanes



Rectangular Rapid Flashing Beacons (RRFB)



Leading Pedestrian Interval



Medians and Pedestrian Refuge Islands in Urban and Suburban Areas



Pedestrian Hybrid Beacons



Road Diets (Roadway Reconfiguration)



Walkways

Crosscutting



Pavement Friction Management



Lighting



Local Road Safety Plans



Road Safety Audit

Introduction

Widespread use of the 28 Proven Safety Countermeasures (PSCs) identified in this booklet can offer significant, measurable impacts as part of any agency's approach to improving safety. These strategies are designed for all road users and all kinds of roads—from rural to urban, from high-volume freeways to less traveled two-lane State and county roads, from signalized crossings to horizontal curves, and everything in between. Each countermeasure addresses at least one safety focus area – speed management, intersections, roadway departures, or pedestrians/bicyclists – while others are crosscutting strategies that address multiple safety focus areas.

Between 2016 and 2020, 85 percent¹ of all public highway fatalities occurred on Federal-aid highways, which represent 25 percent² of the entire public highway network. FHWA's partner agencies have invested in highway safety through the Highway Safety Improvement Program (HSIP), which provides targeted safety funding that is eligible for use on all public roads. However, this dedicated funding source represents only about 6 percent of the total Federal-aid program.³ Every transportation project, whether or not the specific project purpose is safety related, is a new opportunity to save lives on our roadways. The FHWA's Proven Safety Countermeasures are eligible under most Federal-aid highway funding programs, and can support state, local, and tribal agency efforts to effectively accomplish goals to reduce fatalities and serious injuries. These countermeasures should serve as the basis for what agencies consider and implement when designing any highway project to improve safety.

To assist practitioners with determining the most appropriate PSC for their location of interest, the PSC webpage includes a filter tool that allows users to obtain a tailored listing of potential PSCs. Users answer questions regarding area types, functional classification, traffic volumes, issue identified, targeted crash types, and other information to receive a list of PSCs meeting the criteria. This search function is intended to better serve practitioners, including those with limited safety background, when identifying and considering treatments and strategies that can improve safety as part of their program or project.

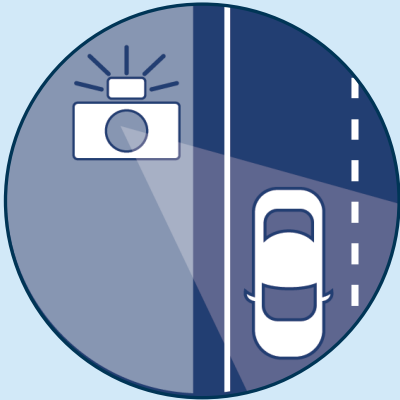
The PSCs can support agencies with implementation of the Safe System Approach, which seeks to build and reinforce multiple layers of protection to both prevent crashes from happening and minimize the harm caused to those involved when crashes do occur. Implementing a Safe System Approach requires collaborative engagement among a diverse group of stakeholders to increase safety for all road users. Accordingly, agencies should consider how the PSCs and National Highway Traffic Safety Administration's (NHTSA) Countermeasures That Work⁴ can create a system with redundancies in place to protect all road users. Reaching our goal of zero deaths and serious injuries requires all of us to take ownership in safety. Together, we can consider the safety needs at every stage of the project development process, the safety impact of every investment decision, and the appropriate safety countermeasures for every Federal-aid project.

1 NHTSA Fatality Analysis Reporting System (FARS) 2016-2020 Final

2 FHWA Highway Statistics 2022 (<https://www.fhwa.dot.gov/policyinformation/statistics/2022/hm16.cfm>)

3 Federal-aid apportioned programs under the Infrastructure Investment and Jobs Act (IIJA) (<https://www.fhwa.dot.gov/bipartisan-infrastructure-law/funding.cfm>)

4 Countermeasures That Work (<https://www.nhtsa.gov/book/countermeasures/countermeasures-that-work>)



Speed Safety Cameras

Safe Speeds is a core principle of the Safe System Approach since humans are less likely to survive high-speed crashes. Enforcing safe speeds has been challenging; however, with more information and tools communities can make progress in reducing speeds. Agencies can use speed safety cameras (SSCs) as an effective and reliable technology to supplement more traditional methods of enforcement, engineering measures, and education to alter the social norms of speeding. SSCs use speed measurement devices to detect speeding and capture photographic or video evidence of vehicles that are violating a set speed threshold.

Safety Benefits:
Fixed units can reduce crashes on urban principal arterials up to:

54% for all crashes.⁴

48% for injury crashes.⁴

P2P units can reduce crashes on urban expressways, freeways, and principal arterials up to:

37%

for fatal and injury crashes.²

Mobile units can reduce crashes on urban principal arterials up to:

20%

for fatal and injury crashes.⁵

In New York City, fixed units reduced speeding in school zones up to 63% during school hours.⁶

For more information on this and other FHWA Proven Safety Countermeasures, please reference the: Speed Safety Camera Program Planning and Operations Guide.

The contents of this Fact Sheet do not have the force and effect of law and are not meant to bind the public in any way. This Fact Sheet is intended only to provide clarity regarding existing requirements under the law or agency policies.

Applications

Agencies should conduct a network analysis of speeding-related crashes to identify locations to implement SSCs. The analysis can include scope (e.g., widespread, localized), location types (e.g., urban/suburban/rural, work zones, residential, school zones), roadway types (e.g., expressways, arterials, local streets), times of day, and road users most affected by speed-related crashes (e.g., pedestrians, bicyclists).

SSCs can be deployed as:

- **Fixed units**—a single, stationary camera targeting one location.
- **Point-to-Point (P2P) units**—multiple cameras to capture average speed over a certain distance.
- **Mobile units**—a portable camera, generally in a vehicle or trailer.

The table below describes suitable circumstances for SSC deployment.¹

Considerations

- SSCs can produce a crash reduction upstream and downstream, thus generating a spillover effect.²

- Public trust is essential for any type of enforcement. With proper controls in place, SSCs can offer fair and equitable enforcement of speeding, regardless of driver age, race, gender, or socio-economic status. SSCs should be planned with community input and equity impacts in mind.

- Using both overt (i.e., highly visible) and covert (i.e., hidden) enforcement may encourage drivers to comply with limits everywhere, not only at sites they are aware are enforced.

- Agencies should conduct evaluations regularly to determine if SSCs are accomplishing safety goals and whether changes in strategy, scheduling, communications, or public engagement are necessary.

- Agencies should conduct a legal and policy review to determine if SSCs are authorized within a jurisdiction and how the authorization and other traffic laws will affect a SSC program.

- Agencies should develop an SSC program plan with consideration of the USDOT SSC guidelines for planning, public involvement, stakeholder coordination, implementation, maintenance, evaluation, etc.³

Considerations for Selection	Fixed	P2P	Mobile
Problems are long-term and site-specific.	X	X	—
Problems are network-wide, and shift based on enforcement efforts.	—	—	X
Speeds at enforcement site vary largely from downstream sites.	—	X	X
Overt enforcement is legally required.	X	X	X
Sight distance for the enforcement unit is limited.	X	X	—
Enforcement sites are multilane facilities.	X	X	—

1 Speed Safety Camera Program Planning and Operations Guide. FHWA, (2023).

2 (CMF ID: 7718) Montella et al. "Effects on speed and safety of point-to-point speed enforcement systems". Accident Analysis and Prevention, Vol. 75, (2015). Note that this is an international study.

3 Speed Enforcement Camera Systems Operational Guidelines. NHTSA, (2008).

4 (CMF ID: 2915, 2921) Shin et al. "Evaluation of the Scottsdale Loop 101 automated speed enforcement demonstration program." Accident Analysis and Prevention, Vol. 41, (2009).

5 (CMF ID: 7582) Li et al. "A Before-and-After Empirical Bayes Evaluation of Automated Mobile Speed Enforcement on Urban Arterial Roads." Presented at the 94th Annual Meeting of the Transportation Research Board, Paper No. 15-1563, Washington, D.C., (2015). Note that this is an international study.

6 Automated Speed Enforcement Program Report 2014-2017. New York City DOT, (2018).



Safety Benefits:

VSLs can reduce crashes on freeways up to:

34%

for total crashes.¹

65%

for rear-end crashes.¹

51%

for fatal and injury crashes.¹

Benefit/Cost Ratios range between¹

9:1 - 40:1

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/safety/speed-management/reference-materials>.

Variable Speed Limits

Selecting appropriate speed limits on roadways is important in maintaining a safe and efficient transportation network. Speed limits are established with an engineering study based on inputs like traffic volumes, operating speeds, roadway characteristics, and crash history. However, conditions on the roadway are susceptible to change in a short amount of time (e.g., congestion, crashes, weather). Drivers typically determine their operating speeds under normal weather conditions on a straight roadway section with good pavement quality and adequate sight distances. If ideal conditions do not exist and the roadway does not meet the driver's expectations, there is a greater chance that a driver error could result in a crash. Providing variable speed limits (VSLs) capable of adapting to changing circumstances could reduce crash frequency and severity.

Speed management strategies, including VSLs, are integral to the Safe Speeds element of the Safe System Approach. Because humans are unlikely to survive high-speed crashes, VSLs reduce speeds so that human injury tolerances are accommodated in three ways: improving visibility, providing additional time for drivers to stop, and reducing impact forces.

Applications

VSLs use prevailing information on the roadway, like traffic speed, volumes, weather, and road surface conditions, to determine appropriate speeds and display them to drivers. This strategy improves safety performance and traffic flow by reducing speed variance (i.e., improving speed harmonization). VSLs may also improve driver expectation by providing information in advance of slowdowns and potential lane closures, which could reduce the probability for secondary crashes. VSLs can mitigate adverse weather conditions or to slow faster-moving traffic as it approaches a queue or bottleneck.

Agencies can implement VSLs for the following applications:



CONGESTION



INCIDENTS



WORK ZONES



INCLEMENT WEATHER

Considerations

- Particularly effective on urban and rural freeways and high-speed arterials with posted speed limits greater than 40 mph.
- Often implemented as part of Active Traffic Management (ATM) plans or incorporated into existing Road Weather Information Systems.
- When used with ATM, VSLs can mitigate rear-end, sideswipe, and other crashes on high-speed roadways.
- May be implemented as a regulatory and/or an advisory system.
- Can be applied to an entire roadway segment or individual lanes.



Source: WSDOT



Safety Benefits:

Traffic fatalities in the City of Seattle decreased 26 percent after the city implemented comprehensive, city-wide speed management strategies and countermeasures inspired by Vision Zero. This included setting speed limits on all non-arterial streets at 20 mph and 200 miles of arterial streets at 25 mph.⁵

One study found that on rural roads, when considering other relevant factors in the engineering study along with the speed distribution, setting a speed limit no more than 5 mph below the 85th-percentile speed may result in fewer total and fatal plus injury crashes, and lead to drivers complying closely with the posted speed limit.⁶

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/safety/speed-management/reference-materials>.

Appropriate Speed Limits for All Road Users

There is broad consensus among global roadway safety experts that speed control is one of the most important methods for reducing fatalities and serious injuries. Speed is an especially important factor on non-limited access roadways where vehicles and vulnerable road users mix.

A driver may not see or be aware of the conditions within a corridor, and may drive at a speed that feels reasonable for themselves but may not be for all users of the system, especially vulnerable road users, including children and seniors. A driver traveling at 30 miles per hour who hits a pedestrian has a 45 percent chance of killing or seriously injuring them.¹ At 20 miles per hour, that percentage drops to 5 percent.¹ A number of cities across the United States, including New York, Washington, Seattle and Minneapolis, have reduced their local speed limits in recent years in an effort to reduce fatalities and serious injuries, with most having to secure State legislative authorization to do so.

States and local jurisdictions should set appropriate speed limits to reduce the significant risks drivers impose on others—especially vulnerable road users—and on themselves. Addressing speed is fundamental to the Safe System Approach to making streets safer, and a growing body of research shows that speed limit changes alone can lead to measurable declines in speeds and crashes.²

Applications

Posted speed limits are often the same as the legislative statutory speed limit. Agencies with designated authorities to set speed limits, which include States, and sometimes local jurisdictions, can establish non-statutory speed limits or designate reduced speed zones, and a growing number are doing so. While non-statutory speed limits must be based on an engineering study, conducted in accordance with the *Manual on Uniform Traffic Control Devices (MUTCD)* involving multiple factors and engineering judgment, FHWA is also encouraging agencies to use the following:³

- Expert Systems tools.
 - [USLIMITS2](#).
 - [NCHRP 966: Posted Speed Limit Setting Procedure and Tool](#).
- Safe System approach.

Based on international experience and implementation in the United States, the use of 20 mph speed zones or speed limits in urban core areas where vulnerable users share the road environment with motorists may result in further safety benefits.⁴

Considerations

When setting a speed limit, agencies should consider a range of factors such as pedestrian and bicyclist activity, crash history, land use context, intersection spacing, driveway density, roadway geometry, roadside conditions, roadway functional classification, traffic volume, and observed speeds.

To achieve desired speeds, agencies often implement other speed management strategies concurrently with setting speed limits, such as self-enforcing roadways, traffic calming, and speed safety cameras. Additional information is in the following FHWA resources:

- [FHWA Speed Management website](#).
- [Self-Enforcing Roadways: A Guidance Report](#).
- [Noteworthy Speed Management Practices](#).
- [Jurisdiction Speed Management Action Plan Development Package](#).
- [Traffic Calming ePrimer](#).

¹ Reducing the speed limit to 20 mph in urban areas: Child deaths and injuries would be decreased.

² Lowering the speed limit from 30 to 25 mph in Boston: effects on vehicle speeds.

³ FHWA's Methods and Practices for Setting Speed Limits: An Informational Report. (2012).

⁴ Recommendations of the Academic Expert Group for the 3rd Global Ministerial Conference on Road Safety.

⁵ https://safety.fhwa.dot.gov/speedmgmt/ref_mats/fhwasa20047/sec8.cfm#foot813

⁶ [Safety and Operational Impacts of Setting Speed Limits below Engineering Recommendations](#).



Safety Benefits:

Wider edge lines can reduce crashes up to:

37%

for non-intersection, fatal and injury crashes on rural, two-lane roads.²

22%

for fatal and injury crashes on rural freeways.³

Benefit Cost Ratio

25:1

for fatal and serious injury crashes on two-lane rural roads.⁴

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/safety/other/visibility/pavement-markings>.

Wider Edge Lines

Roadway departures account for over half of all traffic fatalities in the United States. If drivers cannot clearly identify the edge of the travel lanes and see the road alignment ahead, the risk of roadway departure may be greater. Wider edge lines enhance the visibility of travel lane boundaries compared to traditional edge lines. Edge lines are considered “wider” when the marking width is increased from the minimum normal line width of 4 inches to the maximum normal line width of 6 inches.¹

Applications

Wider edge lines increase drivers’ perception of the edge of the travel lane and can provide a safety benefit to all facility types (e.g., freeways, multilane divided and undivided highways, two-lane highways) in both urban and rural areas.² Wider edge lines are most effective in reducing crashes on rural two-lane highways, especially for single-vehicle crashes.³ Agencies should also consider implementing a systemic approach to wider edge line installation based roadway departure crash risk factors. Potential risk factors for two-lane rural roads include:

- Pavement and shoulder widths.
- Presence of curves.
- Traffic volumes.
- History of nighttime crashes.

Considerations

- Wider edge lines are relatively low cost.
- Wider edge lines can be implemented using existing equipment during maintenance procedures like re-stripping and resurfacing, with the only cost increase being the additional material.
- Paint may have a lower initial cost, but more durable materials (e.g., thermoplastic) may result in a lower life cycle cost based on their longer service life.
- As the number of automated vehicles increases on roadways, wider edge lines may provide better guidance for these vehicles’ sensors.



Source: Texas Transportation Institute

1 Manual on Uniform Traffic Control Devices (MUTCD), Section 3A.04. FHWA, (2023).
 2 (CMF ID: 4737) Park et al. “Safety effects of wider edge lines on rural, two-lane highways. “ Accident Analysis and Prevention Vol. 48, pp.317-325, (2012).
 3 Potts et al. Benefit/Cost Evaluation of MoDOT’s Total Striping and Delineation Program: Phase II. Missouri Department of Transportation, (2011).
 4 Abdel-Rahim et al. Safety Impacts of Using Wider Pavement Markings on Two-Lane Rural Highways in Idaho. Idaho Transportation Department, (2018).



Safety Benefits:

Chevron Signs

25% reduction in nighttime crashes.¹

16% reduction in non-intersection fatal and injury crashes.²

Oversized Chevron Signs

15% reduction in fatal and injury crashes.³

Sequential Dynamic Chevrons

60% reduction in fatal and injury crashes.⁴

In-Lane Curve Warning Pavement Markings

35 - 38% reduction in all crashes.⁵

New Fluorescent Curve Signs or Upgrade Existing Curve Signs to Fluorescent Sheeting

18% reduction in non-intersection, head-on, run-off-road, and sideswipe in rural areas.¹

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/safety/rwd/keep-vehicles-road/horizontal-curve-safety>.

Enhanced Delineation for Horizontal Curves

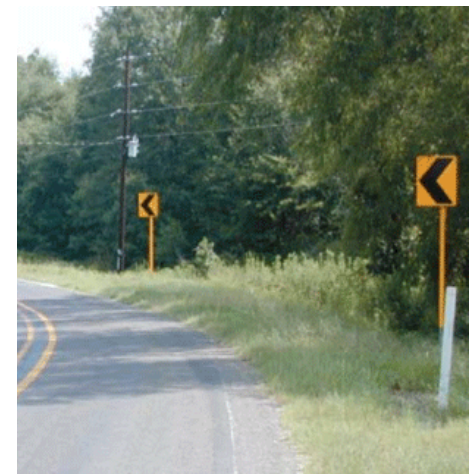
Enhanced delineation at horizontal curves includes a variety of potential strategies that can be implemented in advance of or within curves, in combination, or individually.

Potential Strategies	In Advance of Curve	Within Curve
Pavement markings (standard width or wider)	✓	✓
In-lane curve warning pavement markings	✓	
Retroreflective strips on sign posts	✓	✓
Delineators		✓
Chevron signs		✓
Enhanced Conspicuity (larger, fluorescent, and/or retroreflective signs)	✓	✓
Dynamic curve warning signs (including speed radar feedback signs)	✓	
Sequential dynamic chevrons		✓

Enhanced delineation treatments can alert drivers to upcoming curves, the direction and sharpness of the curve, and appropriate operating speed.

Agencies can take the following steps to implement enhanced delineation strategies:

1. Review signing practices and policies to ensure they comply with the Manual on Uniform Traffic Control Devices (MUTCD) principles of traffic control devices. Consistent practice for similar curves sets the appropriate driver expectancy.
2. Use the [systemic approach](#) to identify and treat problem curves. For example, Minnesota uses risk factors that include curve radii between 500 and 1,200 ft, traffic volumes between 500 and 1,000 vehicles per day, intersection in the curve, and presence of a visual trap.¹
3. Match the appropriate strategy to the identified problem(s), considering the full range of enhanced delineation treatments. Once the MUTCD requirements and recommendations have been met, an incremental approach is often beneficial to avoid excessive cost.



Chevron signs with retroreflective strips on sign posts installed along a curve. Source: FHWA

1 (CMF ID: [2439,2431,2432](#)) Albin et al. Low-Cost Treatments for Horizontal Curve Safety 2016. FHWA-SA-15-084, (2016).

2 (CMF ID: [2438](#)) Srinivasan et al. Safety Evaluation of Improved Curve Delineation. FHWA-HRT-09-045, (2009).

3 (CMF ID: [8978](#)) Lyon et al. Safety Evaluation of Two Curve Warning Treatments: In-Lane Curve Warning Pavement Markings and Oversized Chevron Signs. Presented at the 96th TRB Annual Meeting, Paper No. 17-00432, (2017).

4 (CMF ID: [10362](#)) Hallmark, S. Evaluation of Sequential Dynamic Chevrons on Rural Two-lane Highways. FHWA, (2017).

5 (CMF ID: [10312,9167](#)) Donnell et al. Reducing Roadway Departure Crashes at Horizontal Curve Sections on Two-lane Rural Highways. FHWA-SA-19-005, (2019).



Safety Benefits:

Center Line Rumble Strips

44-64%

reduction in head-on fatal and injury crashes on two-lane rural roads.⁴

Shoulder Rumble Strips

13-51%

reduction in single vehicle, run-off-road fatal and injury crashes on two-lane rural roads.⁴

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/safety/rwd/keep-vehicles-road/rumble-strips>.

Longitudinal Rumble Strips and Stripes

Longitudinal rumble strips are milled or raised elements on the pavement intended to alert drivers through vibration and sound that their vehicle has left the travel lane. They can be installed on the shoulder, edge line, or at or near the center line of an undivided roadway.

Rumble stripes are edge line or center line rumble strips where the pavement marking is placed over the rumble strip. This can increase the visibility and durability of the pavement marking during wet, nighttime conditions, and can improve the durability of the marking on roads with snowplowing operations.

With roadway departure crashes accounting for more than half of the fatal roadway crashes annually in the United States, rumble strips and stripes are designed to address these crashes by alerting distracted, drowsy, or otherwise inattentive drivers who drift from their lane. They are most effective when deployed systemically.

Transportation agencies should consider milled center line rumble strips (including in passing zone areas) and milled edge line or shoulder rumble strips with bicycle gaps for systemic safety projects, location-specific corridor safety improvements, as well as reconstruction or resurfacing projects.

Considerations

- Rumble strips are relatively low-cost, and economic analyses have indicated benefit/cost ratios that exceed 100.¹
- Where rumble strips cannot be placed due to noise concerns, agencies may consider a design using an oscillating sine wave pattern (also known as “mumble strips”) that reduces noise outside of the vehicle. However, the safety benefits of this design need more study.²

Maintenance concerns:

- Where rumble strips are placed along a pavement joint, there are typically no issues with joint stability if the pavement structure and joint was already in good condition.
- Studies have shown no evidence of issues related to snow, ice, or rain build-up in the rumble strip.³



Shoulder rumble strips and center line rumble stripes are installed on this roadway. Source: FHWA



Example of an edge line rumble stripe. Source: Missouri DOT

¹ Himes, S., and McGee, H. Decision Support Guide for the Installation of Shoulder and Center Line Rumble Strips on Non-Freeways. Federal Highway Administration Report No. FHWA-SA-16-115. (August 2016).
² Bedsole et al. *Did You Hear That?* Public Roads Magazine, Volume 80, No. 4. FHWA Publication No. FHWA-HRT-17-002. (2017).
³ NCHRP Synthesis 339: Centerline Rumble Strips – A Synthesis of Highway Practices, (2005)
⁴ (CMF ID: 3358, 3356, 3425, 3648) NCHRP Report 641: Guidance for the Design and Application of Shoulder and Centerline Rumble Strips, (2009).



Proven Safety Countermeasures



Safety Benefits:

11%

reduction in fatal and injury crashes.²

21%

reduction in run-off-road crashes.²

19%

reduction in head-on crashes.²

Benefit-Cost Ratio Range³

700:1 to 1,500:1

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/safety/rwd/provide-safe-recovery/safetyedge>.

SafetyEdgeSM

The SafetyEdgeSM technology shapes the edge of the pavement at approximately 30 degrees from the pavement cross slope during the paving process. This safety practice eliminates the potential for vertical drop-off at the pavement edge, has minimal effect on project cost, and can improve pavement durability by reducing edge raveling of asphalt.

Rural road crashes involving edge drop-offs are 2-4 times more likely to include a fatality than other crashes on similar roads.¹ Vehicles may leave the roadway for various reasons ranging from distracted driver errors to low visibility, or to the presence of an animal on the road. Exposed vertical pavement edges can cause vehicles to become unstable and prevent their safe return to the roadway. The SafetyEdgeSM gives drivers the opportunity to return to their travel lane while maintaining control of their vehicle.

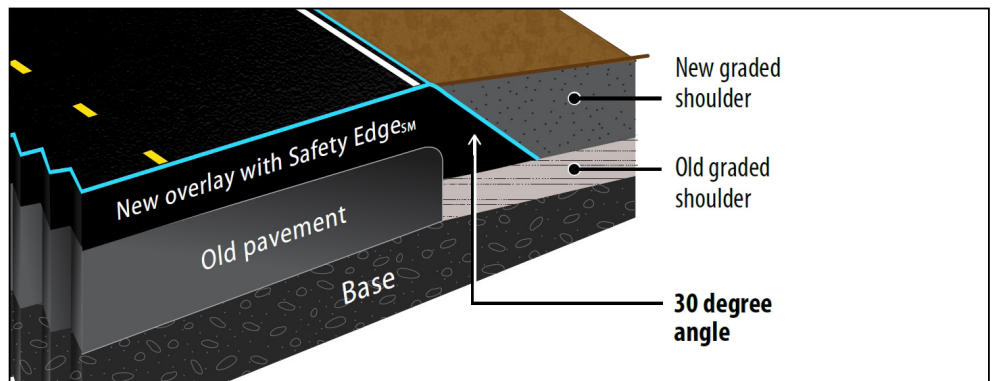
The SafetyEdgeSM technology only requires adding one of several commercially available devices to the screed or endgate when placing hot-mix asphalt. Forms for shaping the edge of concrete pavement are simpler and can be made on site by the contractor. Some agencies allow the SafetyEdgeSM to remain exposed while a segment is under construction, unlike conventional pavement edges. However, before construction ends, agencies should bring the adjacent roadside flush with the top of the pavement

for both the SafetyEdgeSM and traditional pavement edge. Over time, regardless of the edge type, the edge may become exposed due to settling, erosion, and tire wear. When this occurs, the gentle slope provided by the SafetyEdgeSM is preferred versus the traditional vertical pavement edge.

Transportation agencies should develop standards for implementing the SafetyEdgeSM systemwide on all new asphalt paving and resurfacing projects where curbs and/or guardrail are not present, while also encouraging standard application for concrete pavements.



Example of the SafetyEdgeSM after backfill material settles or erodes. Source: FHWA



Cross-section view of an overlay with the SafetyEdgeSM. Source: FHWA-SA-17-044

1 Hallmark et al. Safety Impacts of Pavement Edge Drop-offs, (Washington, DC: AAA Foundation for Traffic Safety; 2006), p 93.

2 (CMF ID: 9205, 9211, 9217) Donnell et al. Development of Crash Modification Factors for the Application of the SafetyEdgeSM on Two-Lane Rural Roads. FHWA-HRT-17-081, (2017).

3 Safety Effects of the SafetyEdgeSM, FHWA-SA-17-044, (2017).



Safety Benefits:

Flatten sideslope from
1V:3H to 1V:4H:

8%

reduction for
single-vehicle crashes.²

Flatten sideslope from
1V:4H to 1V:6H:

12%

reduction for
single-vehicle crashes.²

Increase the distance to
roadside features from
3.3 ft to 16.7 ft:

22%

reduction for all crashes.³

Increase the distance to
roadside features from
16.7 ft to 30 ft:

44%

reduction for all crashes.³

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/safety/rwd/provide-safe-recovery/clear-zones/clear-zones>.

Roadside Design Improvements at Curves

Horizontal curves account for 27 percent of all fatal crashes and 80 percent of all fatal crashes at curves are roadway departure crashes.¹ Roadside design improvements at curves is a strategy encompassing several treatments that target the high-risk roadside environment along the outside of horizontal curves. These treatments can reduce roadway departure fatalities and serious injuries by giving vehicles the opportunity to recover safely and by reducing crash severity.

Roadside design improvements can be implemented alone or in combination, and are particularly recommended at horizontal curves—where data indicates a higher risk for roadway departure fatalities and serious injuries.

Roadside Design Improvements to Provide for a Safe Recovery

In cases where a vehicle leaves the roadway, having strategic roadside design elements, including an added or widened shoulder, flattened sideslopes, or a widened clear zone can provide drivers with an opportunity to regain control and re-enter the roadway in their lane or come to a safe stop before rolling over or encountering a fixed object.

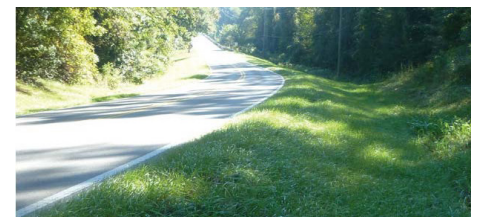
- A **clear zone** is an unobstructed, traversable roadside area that allows a driver to stop safely or regain control of a vehicle that has left the roadway. Agencies should avoid adding new fixed objects such as trees and utility cabinets or poles in the clear zone. AASHTO's *Roadside Design Guide* details the clear zone width adjustment factors to be applied at horizontal curves.
- **Slope flattening** reduces the steepness of the sideslope to increase drivers' ability to keep the vehicle stable, regain control of the vehicle, and avoid obstacles. Slopes of 1V:4H or flatter are considered recoverable (i.e., drivers can retain control of a vehicle by slowing or stopping). Slopes between 1V:3H and 1V:4H are generally considered traversable, but non-recoverable (i.e., errant vehicle will continue to the bottom of the slope).

- **Adding or widening shoulders** gives drivers more recovery area to regain control in the event of a roadway departure.

Roadside Design Improvements to Reduce Crash Severity

Since not all roadside hazards can be removed, relocated, or redesigned at curves, installing roadside barriers to shield unmovable objects or steep embankments may be an appropriate treatment. Three common types of roadside barriers are:

- **Cable barrier** is a flexible barrier made from steel cables mounted on weak steel posts. Flexible barriers are more forgiving and have the most deflection.
- **Metal-beam guardrail** is a semi-rigid barrier where a W-beam or box-beam is mounted on steel or timber posts. These deflect less than cable barriers, so they can be located closer to objects where space is limited.
- **Concrete barrier** is a rigid barrier that has little to no deflection.



Clear zone provided on the outside of the curve. Source: FHWA.

1 Fatality Analysis Reporting System.

2 (CMF ID: [4627.4632](#)) NCHRP Report 617: Accident Modification Factors for Traffic Engineering and ITS Improvements, (2008).

3 (CMF ID: [35.36](#)) Elvik, R., and Vaa, T. Handbook of Road Safety Measures, (2004).



8%

of all fatalities on divided highways are due to head-on crashes.¹

Safety Benefits:
Median Barriers Installed on Rural Four-Lane Freeways

97%

reduction in cross-median crashes.²

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/safety/rwd/reduce-crash-severity>.

Median Barriers

Median barriers are longitudinal barriers that separate opposing traffic on a divided highway and are designed to redirect vehicles striking either side of the barrier. Median barriers significantly reduce the number of cross-median crashes, which are attributed to the relatively high speeds that are typical on divided highways. AASHTO's *Roadside Design Guide* (RDG) recommends guidelines for the use of median barriers on high-speed, fully controlled-access roadways for locations where the median is 30 ft in width or less and the average daily traffic (ADT) is greater than 20,000 vehicles per day (vpd). For locations with median widths greater than 50 ft and where the ADT is less than 20,000 vpd, a median barrier is optional. For locations where the median is between 30 and 50 feet, the RDG suggests an analysis to determine the cost effectiveness of median barrier installation. Median barriers can be cable, metal-beam, or concrete.

- **Cable barriers** are flexible barriers, made from steel cables mounted on weak steel posts, resulting in less occupant impact force as it absorbs energy from the crash, capturing or redirecting the vehicle. Due to larger deflection, median width is an important consideration. These barriers are more adaptable to slopes typically found in medians. Cable barriers tend to require more frequent maintenance and repair than other barrier types.
- **Metal-beam guardrails** are considered semi-rigid barriers, where the W-beam or box-beam is mounted to steel or timber posts. When impacted, they are designed to deform and deflect, absorbing some of the crash energy and redirecting the vehicle. Metal-beam guardrails often do not require maintenance after minor impacts. They deflect less than cable barriers, so they can be located closer to objects where space is limited.
- **Concrete barriers** are usually rigid and result in little to no deflection. They redirect rather than absorb energy from the impact. Rigid concrete barriers seldom require repair or maintenance. Some agencies have used portable concrete barriers as median barriers. These barriers require

repositioning after an impact but are typically less maintenance than a post mounted barrier.

To reduce cross-median crashes, transportation agencies should review their head-on crash history on divided highways to identify hot spots. Agencies should also consider implementing a systemic approach to median barrier placement based on cross-median crash risk factors. Potential risk factors include:

- Traffic volumes.
- Vehicle classifications.
- Median crossover history.
- Crash incidents.
- Vertical and horizontal alignment.
- Median terrain configurations.



Median cable barrier prevents a potential head-on crash. Source: Washington State DOT

¹ Fatality Analysis Reporting System.

² (CMF ID: 7040) NCHRP Report 794: Median Cross-Section Design for Rural Divided Highways. (2011).



Safety Benefits:

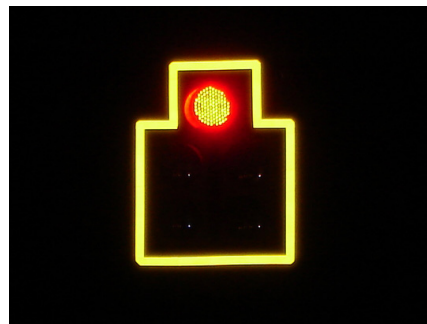
15%

reduction in total crashes.¹

Backplates with Retroreflective Borders

Backplates added to a traffic signal head improve the visibility of the illuminated face of the signal by introducing a controlled-contrast background. The improved visibility of a signal head with a backplate is made even more conspicuous by framing it with a 1- to 3-inch yellow retroreflective border. Signal heads that have backplates equipped with retroreflective borders are more visible and conspicuous in both daytime and nighttime conditions.

This treatment is recognized as a human factors enhancement of traffic signal visibility, conspicuity, and orientation for both older and color vision deficient drivers. This countermeasure is also advantageous during periods of power outages when the signals would otherwise be dark, providing a visible cue for motorists to stop at the intersection ahead.



Retroreflective borders are highly visible during the night. Source: South Carolina DOT

safety countermeasure is to adopt it as a standard treatment for signalized intersections across a jurisdiction or State.

Implementation challenges include minimizing installation time, accessing existing signal heads, and structural limitations due to added wind load in instances where an entire backplate is added. Agencies should consider the design of the existing signal support structure to determine if the design is sufficient to support the added wind load.

Considerations

Transportation agencies should consider backplates with retroreflective borders as part of their efforts to systematically improve safety performance at signalized intersections. Adding a retroreflective border to an existing signal backplate is a very low-cost safety treatment. This can be done by either adding retroreflective tape to an existing backplate or purchasing a new backplate with a retroreflective border already incorporated. The most efficient means of implementing this proven



Signal backplate framed with a retroreflective border. Source: FHWA

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://rosap.nfl.bts.gov/view/dot/42807>.

¹ (CMF ID: 1410) Sayed, T., Leur, P., and Pump, J., "Safety Impact of Increased Traffic Signal Backboards Conspicuity," 2005 TRB 84th Annual Meeting: Compendium of Papers CD-ROM, Vol. TRB#05-16, Washington, D.C., (2005).



Safety Benefits:

Reducing driveway density

5-23%

reduction in total crashes along 2-lane rural roads.³

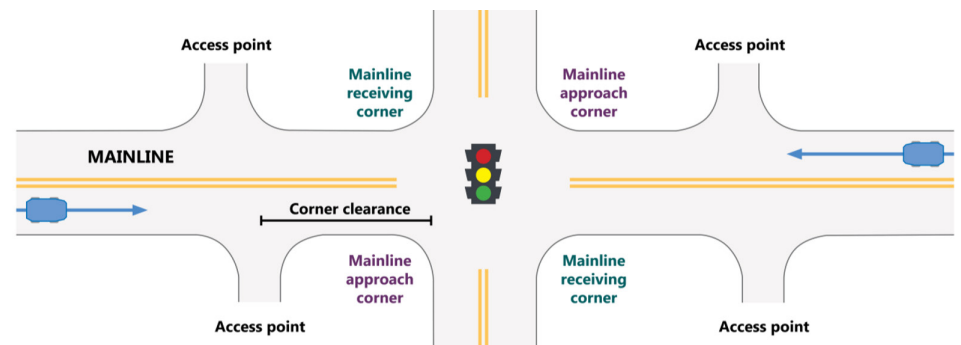
25-31%

reduction in fatal and injury crashes along urban/suburban arterials.⁴

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/safety/intersection-safety/cam>.

Corridor Access Management

Access management refers to the design, application, and control of entry and exit points along a roadway. This includes intersections with other roads and driveways that serve adjacent properties. Thoughtful access management along a corridor can simultaneously enhance safety for all modes, facilitate walking and biking, and reduce trip delay and congestion.



Schematic of an intersection and adjacent access points. Source: FHWA

Every intersection, from a signalized intersection to an unpaved driveway, has the potential for conflicts between vehicles, pedestrians, and bicyclists. The number and types of conflict points—locations where the travel paths of two users intersect—influence the safety performance of the intersection or driveway. FHWA developed corridor-level crash prediction models to estimate and analyze the safety effects of selected access management techniques for different area types, land uses, roadway variables, and traffic volumes.¹

The following access management strategies can be used individually or in combination with one another:

- Reduce density through driveway closure, consolidation, or relocation.
- Manage spacing of intersection and access points.
- Limit allowable movements at driveways (such as right-in/right-out only).

- Place driveways on an intersection approach corner rather than a receiving corner, which is expected to have fewer total crashes.²
- Implement raised medians that preclude across-roadway movements.
- Utilize designs such as roundabouts or reduced left-turn conflicts (such as restricted crossing U-turn, median U-turns, etc.).
- Provide turn lanes (i.e., left-only, right-only, or interior two-way left).
- Use lower speed one-way or two-way off-arterial circulation roads.

Successful corridor access management involves balancing overall safety and mobility for all users along with the needs of adjacent land uses.



Tandem roundabouts with a continuous raised median eliminates left-turn and across-roadway conflicts. Source: FHWA

1 Gross et al. Safety Evaluation of Access Management Policies and Techniques. FHWA-HRT-14-057, (2018).
2 Le et al. Safety Evaluation of Corner Clearance at Signalized Intersections. FHWA-HRT-17-084, (2018).
3 Harwood et al. Prediction of the Expected Safety Performance of Rural Two-Lane Highways. FHWA-RD-99-207, (2000).
4 (CMF ID: 179,178) Elvik, R. and Vaa, T., Handbook of Road Safety Measures. Oxford, United Kingdom, Elsevier, (2004).



Safety Benefits:

Left-Turn Lanes

28-48%

reduction in total crashes.¹

Positive Offset Left-Turn Lanes

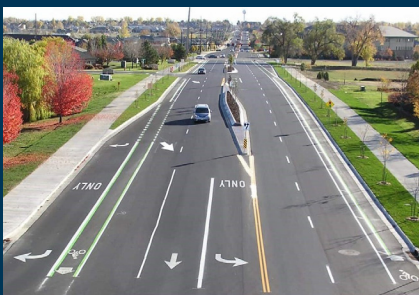
36%

reduction in fatal and injury crashes.²

Right-Turn Lanes

14-26%

reduction in total crashes.¹



Left- and right-turn lanes at a two-way stop-controlled intersection. Source: City of Greeley, CO

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://www.fhwa.dot.gov/publications/research/safety/02103/02103techbrief.pdf>.

Dedicated Left- and Right-Turn Lanes at Intersections

Auxiliary turn lanes—either for left turns or right turns—provide physical separation between turning traffic that is slowing or stopped and adjacent through traffic at approaches to intersections. Turn lanes can be designed to provide for deceleration prior to a turn, as well as for storage of vehicles that are stopped and waiting for the opportunity to complete a turn.

While turn lanes provide measurable safety and operational benefits at many types of intersections, they are particularly helpful at two-way stop-controlled intersections. Crashes occurring at these intersections are often related to turning maneuvers. Since the major route traffic is free flowing and typically travels at higher speeds, crashes that do occur are often severe. The main crash types include collisions of vehicles turning left across opposing through traffic and rear-end collisions of vehicles turning left or right with other vehicles following closely behind. Turn lanes reduce the potential for these types of crashes.

Installing left-turn lanes and/or right-turn lanes should be considered for the major road approaches for improving safety at both three- and four-leg intersections with stop control on the minor road, where significant turning volumes exist, or where there is a history of turn-related crashes. Pedestrian and bicyclist safety and convenience should also be considered when adding turn lanes at an intersection. Specifically, offset left- and right-turn

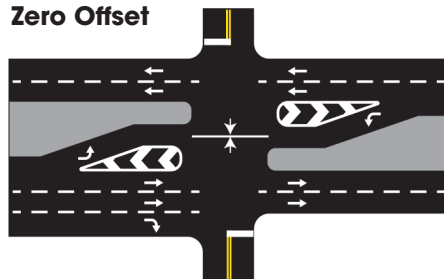
lanes will lengthen crossing distances for pedestrians.

Offset Turn Lanes

Providing offset of left- and right-turn lanes to increase visibility can provide added safety benefits, and is preferable in many situations, particularly at locations with higher speeds, or where free-flow or permissive movements are possible.

At turn lanes with zero or negative offset, turning vehicles can block sightlines. For left-turn lanes, this usually involves opposing left-turning vehicles occupying the turn lanes at the same time. For right-turn lanes, this typically involves right-turning vehicles from the major road and vehicles entering the intersection from the minor road. In both scenarios, adding positive offset to turn lanes enhances the sight distance to approaching vehicles that conflict with the turning movement. Offset turn lanes should be considered when there is a high frequency of these types of conflicts in order to reduce the likelihood of a severe crash.

Zero Offset



Positive Offset

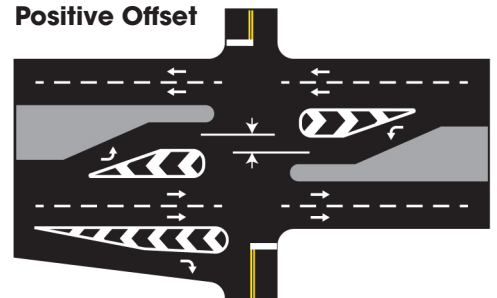


Illustration comparing zero offset to positive offset of left- and right-turn lanes. Source: FHWA

1 (CMF ID: 260, 268, 285, 289) Harwood et al. Safety Effectiveness of Intersection Left- and Right-Turn Lanes. FHWA-HRD-02-089, (2002).
2 (CMF ID: 6096) Persaud et al. Safety Evaluation of Offset Improvements for Left-Turn Lanes. FHWA-HRT-09-035, (2009).



Safety Benefits:

RCUT

Two-Way
Stop-Controlled to RCUT:

54%

reduction in fatal
and injury crashes.²

Signalized Intersection
to Signalized RCUT:

22%

reduction in fatal
and injury crashes.³

Unsignalized Intersection
to Unsignalized RCUT:

63%

reduction in fatal and
injury crashes.⁴

MUT

30%

reduction in intersection-
related injury crash rate.⁵

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/safety/intersection-safety/intersection-types/reduced-left-turn-conflict-intersections>

Reduced Left-Turn Conflict Intersections

Reduced left-turn conflict intersections are geometric designs that alter how left-turn movements occur. These intersections simplify decision-making for drivers and minimize the potential for higher severity crash types, such as head-on and angle. Two highly effective designs that rely on U-turns to complete certain left-turn movements are known as the Restricted Crossing U-turn (RCUT) and the Median U-turn (MUT).

Restricted Crossing U-turn

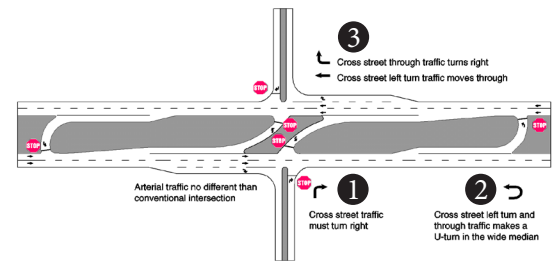
The RCUT intersection, also known as a J-Turn, Superstreet, or Reduced Conflict Intersection, modifies the direct left-turn and through movements from cross-street approaches. Minor road traffic makes a right turn followed by a U-turn at a designated location—either signalized or unsignalized—to continue in the desired direction. The RCUT is suitable for and adaptable to a wide variety of circumstances, ranging from isolated rural, high-speed locations to urban and suburban high-volume, multimodal corridors. It is a competitive and less costly alternative to constructing an interchange. RCUTs work well when consistently used along a corridor, but also can be used effectively at individual intersections. Studies have shown that installing an RCUT can result in a 30-percent increase in throughput and a 40-percent reduction in network intersection travel time.¹

Median U-turn

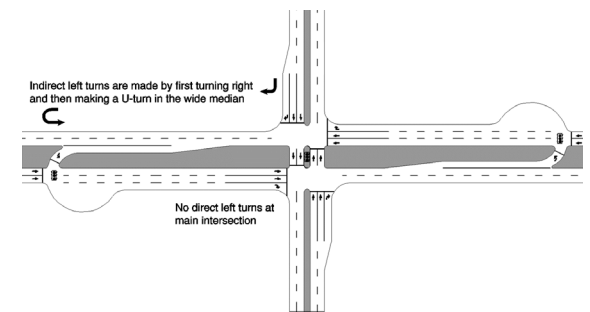
The MUT intersection modifies direct left turns from the major approaches. Vehicles proceed through the main intersection, make a U-turn a short distance downstream, followed by a right turn at the main intersection. The U-turns can also be used for

modifying the cross-street left turns, similar to the RCUT.

The MUT is an excellent choice for intersections with heavy through traffic and moderate left-turn volumes. Studies have shown a 20- to 50-percent improvement in intersection throughput for various lane configurations as a result of implementing the MUT design. When implemented at multiple intersections along a corridor, the efficient two-phase signal operation of the MUT can reduce delay, improve travel times, and create more crossing opportunities for pedestrians and bicyclists.



Example of an unsignalized RCUT intersection. Source: FHWA



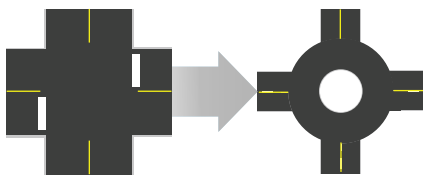
Example of a MUT intersection. Source: FHWA

1 Hugher and Jagannathan. Restricted Crossing U-Turn Intersection. FHWA-HRT-09-059, (2009).
2 (CMF ID: 5556) Edara et al. Evaluation of J-turn Intersection Design Performance in Missouri. MoDOT, (2013).
3 (CMF ID: 9985) Hummer and Rao. Safety Evaluation of a Signalized Restricted Crossing U-Turn. FHWA-HRT-17-082, (2017).
4 (CMF ID: 4884) Hummer et al. Superstreet Benefits and Capacities. FHWA/NC/2009-06. NC State University, (2010).
5 (CMF ID: 10867) Synthesis of the Median U-Turn Treatment, Safety, and Operational Benefits, FHWA-HRT-07-033, (2007).



Safety Benefits:

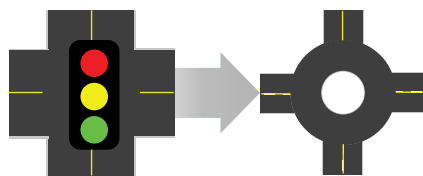
Two-Way Stop-Controlled Intersection to a Roundabout



82%

reduction in fatal and injury crashes.¹

Signalized Intersection to a Roundabout



78%

reduction in fatal and injury crashes.¹

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/safety/intersection-safety/intersection-types/roundabouts>.

Roundabouts

The modern roundabout is an intersection with a circular configuration that safely and efficiently moves traffic. Roundabouts feature channelized, curved approaches that reduce vehicle speed, entry yield control that gives right-of-way to circulating traffic, and counterclockwise flow around a central island that minimizes conflict points. The net result of lower speeds and reduced conflicts at roundabouts is an environment where crashes that cause injury or fatality are substantially reduced.

Roundabouts are not only a safer type of intersection; they are also efficient in terms of keeping people moving. Even while calming traffic, they can reduce delay and queuing when compared to other intersection alternatives. Furthermore, the lower vehicular speeds and reduced conflict environment can create a more suitable environment for walking and bicycling.

Roundabouts can be implemented in both urban and rural areas under a wide range of traffic conditions. They can replace signals, two-way stop controls, and all-way stop controls. Roundabouts are an effective option for managing speed and transitioning traffic from high-speed to low-speed environments, such as freeway interchange ramp terminals, and rural intersections along high-speed roads.

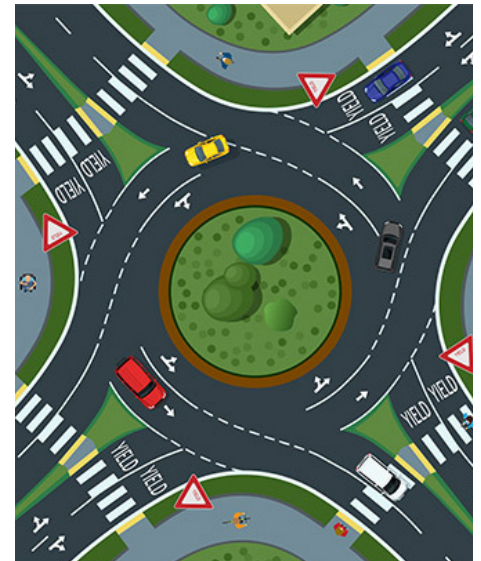


Illustration of a multilane roundabout. Source: FHWA



Example of a single-lane roundabout. Source: FHWA

¹ (CMF ID: 211,226) AASHTO. The Highway Safety Manual, American Association of State Highway Transportation Professionals, Washington, D.C., (2010).



Safety Benefits:

10%

reduction of fatal and injury crashes at all locations/types/areas.

15%

reduction of nighttime crashes at all locations/types/areas.

27%

reduction of fatal and injury crashes at rural intersections.

19%

reduction of fatal and injury crashes at 2-lane by 2-lane intersections.

Average Benefit-Cost Ratio

12:1

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/sites/fhwa.dot.gov/files/2022-06/fhwasa18047.pdf>.

Systemic Application of Multiple Low-Cost Countermeasures at Stop-Controlled Intersections

This systemic approach to intersection safety involves deploying a package of multiple low-cost countermeasures, including enhanced signing and pavement markings, at a large number of stop-controlled intersections within a jurisdiction. These countermeasures increase driver awareness and recognition of the intersections and potential conflicts.

There are several benefits to systemically applying multiple low-cost countermeasures at stop-controlled intersections, including,

- Resources are maximized because the treatments are low cost.
- A high number of intersections can receive treatment.
- Improvements are highly cost-effective, with an average benefit-cost ratio of 12:1, even assuming a conservative 3-year service life.

The low-cost countermeasures for stop-controlled intersections generally consist of the following treatments:

On the Through Approach

- Doubled-up (left and right), oversized advance intersection warning signs, with supplemental street name plaques (can also include flashing beacon).
- Retroreflective sheeting on sign posts.
- Enhanced pavement markings that delineate through lane edge lines.



Example of countermeasures on the through approach.
Source: South Carolina DOT

On the Stop Approach

- Doubled-up (left and right), oversized advance "Stop Ahead" intersection warning signs (can also include flashing beacon).
- Doubled-up (left and right), oversized Stop signs.
- Retroreflective sheeting on sign posts.
- Properly placed stop bar.
- Removal of vegetation, parking, or obstructions that limit sight distance.
- Double arrow warning sign at stem of T-intersections.



Example of countermeasures on the stop approach.
Source: South Carolina DOT

Source: (CMF ID: [8867](#), [8870](#), [8874](#), [8893](#)) T. Le et al. "Safety Effects of Low-Cost Systemic Safety Improvements at Signalized and Stop-Controlled Intersections." 96th Annual Meeting of the Transportation Research Board, Paper Number 17-05379, January 2017.



Safety Benefits:

36-50%
reduction in
red light running.³

8-14%
reduction in
total crashes.³

12%
reduction in
injury crashes.³

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/sites/fhwa.dot.gov/files/2022-06/fhwas13027.pdf>.

Yellow Change Intervals

At a signalized intersection, the yellow change interval is the length of time that the yellow signal indication is displayed following a green signal indication. The yellow signal confirms to motorists that the green has ended and that a red will soon follow.

Since red-light running is a leading cause of severe crashes at signalized intersections, it is imperative that the yellow change interval be appropriately timed. Too brief an interval may result in drivers being unable to stop safely and cause unintentional red-light running. Too long of an interval may result in drivers treating the yellow as an extension of the green phase and invite intentional red-light running. Factors such as the speed of approaching and turning vehicles, driver perception-reaction time, vehicle deceleration, and intersection geometry should all be considered in the timing calculation.

Transportation agencies can improve signalized intersection safety and reduce red-light running by reviewing and updating their traffic signal timing policies and procedures concerning the yellow change interval. Agencies should institute regular evaluation and adjustment protocols for existing traffic signal timing. Refer to the *Manual on Uniform Traffic Control Devices* for basic requirements and further recommendations about yellow change interval timing.¹ As part of strategic signal system modernization and updates, incorporating automated traffic signal performance measures (ATSPMs) is a proven approach to improve on traditional retiming processes. ATSPMs provide continuous performance monitoring capability and the ability to modify timing based on actual performance, without requiring expensive modeling or data collection.²



Appropriately timed yellow change intervals can reduce red-light running and improve overall intersection safety. Source: FHWA

¹ Manual on Uniform Traffic Control Devices (MUTCD), Section 4F.17, FHWA, (2023).
² Federal Highway Administration. "Automated Traffic Signal Performance," (2020).
³ (CMF ID: 380,384) NCHRP Report 731: Guidelines for Timing Yellow and All-Red Intervals at Signalized Intersections, (2011).



Safety Benefits:

High-visibility crosswalks can reduce pedestrian injury crashes up to: 40%¹

Intersection lighting can reduce pedestrian crashes up to: 42%²

Advance yield or stop markings and signs can reduce pedestrian crashes up to: 25%³

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/sites/fhwa.dot.gov/files/2022-06/techSheetVizEnhancemt2018.pdf>.

Crosswalk Visibility Enhancements

Poor lighting conditions, obstructions such as parked cars, and horizontal or vertical roadway curvature can reduce visibility at crosswalks, contributing to safety issues. For multilane roadway crossings where vehicle volumes are in excess of 10,000 Average Annual Daily Traffic (AADT), a marked crosswalk alone is typically not sufficient. Under such conditions, more substantial crossing improvements could prevent an increase in pedestrian crash potential.

Three main crosswalk visibility enhancements help make crosswalks and the pedestrians, bicyclists, wheelchair and other mobility device users, and transit users using them more visible to drivers. These include high-visibility crosswalks, lighting, and signing and pavement markings. These enhancements can also assist users in deciding where to cross. Agencies can implement these features as standalone or combination enhancements to indicate the preferred location for users to cross.

High-visibility crosswalks

High-visibility crosswalks use patterns (i.e., bar pairs, continental, ladder) that are visible to both the driver and pedestrian from farther away compared to traditional transverse line crosswalks. They should be considered at all midblock pedestrian crossings and uncontrolled intersections. Agencies should use materials such as inlay or thermoplastic tape, instead of paint or brick, for highly reflective crosswalk markings.

Improved Lighting

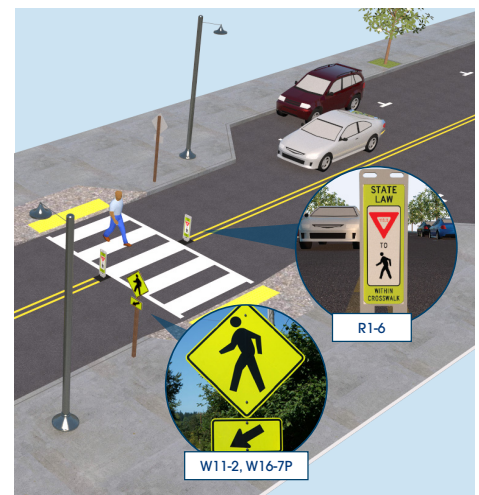
The goal of crosswalk lighting should be to illuminate with positive contrast to make it easier for a driver to visually identify the pedestrian. This involves carefully placing the luminaires in forward locations to avoid a silhouette effect of the pedestrian.

Enhanced Signing and Pavement Markings

On multilane roadways, agencies can use "YIELD Here to Pedestrians" or "STOP Here for Pedestrians" signs 20 to 50 feet in advance of

a marked crosswalk to indicate where a driver should stop or yield to pedestrians, depending on State law. To supplement the signing, agencies can also install a STOP or YIELD bar (commonly referred to as "shark's teeth") pavement markings.

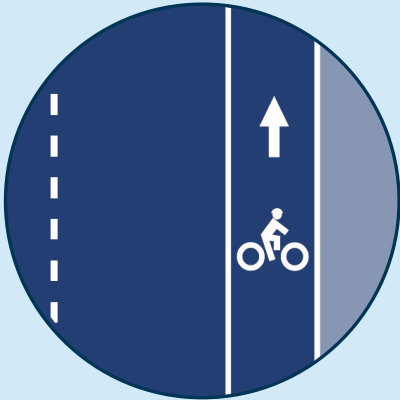
In-street signing, such as "STOP Here for Pedestrians" or "YIELD Here to Pedestrians" may be appropriate on roads with two- or three-lane roads where speed limits are 30 miles per hour or less.



Source: FHWA

1 (CMF ID: 4123) Chen, L., C. Chen, and R. Ewing. The Relative Effectiveness of Pedestrian Safety Countermeasures at Urban Intersections - Lessons from a New York City Experience. (2012).
2 (CMF ID: 436) Elvik, R. and Vaa, T. Handbook of Road Safety Measures. Oxford, United Kingdom, Elsevier, (2004).
3 (CMF ID: 9017) Zeeger et al. Development of Crash Modification Factors for Uncontrolled Pedestrian Crossing Treatments, FHWA, (2017).

Transportation agencies should refer to the Manual on Uniform Traffic Control Devices (MUTCD) for information on crosswalk markings (Chapter 3C) and in-street signing (Sections 2B.19 and 2B.20).



Safety Benefits:

Converting traditional or flush buffered bicycle lanes to a separated bicycle lane with flexible delineator posts can reduce crashes up to:

53%

for bicycle/vehicle crashes.³

Bicycle Lane Additions can reduce crashes up to:

49%

for total crashes on urban 4-lane undivided collectors and local roads.⁷

30%

for total crashes on urban 2-lane undivided collectors and local roads.⁷



Bicycle lane in Washington, DC.
Source: Alex Baca, Washington Area
Bicyclist Association.

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/sites/fhwa.dot.gov/files/2022-07/10071.pdf>.

Bicycle Lanes

Most fatal and serious injury bicyclist crashes occur at non-intersection locations. Nearly one-third of these crashes occur when motorists are overtaking bicyclists¹ because the speed and size differential between vehicles and bicycles can lead to severe injury. Many people are not comfortable riding a bicycle because of their fear that this type of crash may occur. To make bicycling safer and more comfortable for most types of bicyclists, State and local agencies should consider installing bicycle lanes. Providing bicycle facilities can mitigate or prevent interactions, conflicts, and crashes between bicyclists and motor vehicles, and create a network of safer roadways for bicycling. Bicycle Lanes align with the Safe System Approach principle of recognizing human vulnerability—where separating users in space can enhance safety for all road users.

Applications

The FHWA's [Bikeway Selection Guide](#) and [Incorporating On-Road Bicycle Networks into Resurfacing Projects](#) assist agencies in determining which facilities provide the most benefit in various contexts. Bicycle lanes can be included on new roadways or created on existing roads by reallocating space in the right-of-way through [Road Diets](#). Separated bicycle lanes, which use vertical elements—such as flexible delineator posts, curbs, or vegetation—between the bicycle lane and motorized traffic lanes provide additional safety benefits.^{2,3} For a marked bike lane without vertical elements, a lateral offset with marked buffer can help to further separate bicyclists from vehicle traffic.

Considerations

- In order to maximize a roadway's suitability for riders of all ages and abilities, bicycle lane design should vary according to roadway characteristics (number of lanes, motor vehicle and truck volumes, speed, presence of transit), user needs (current and forecasted ridership, types of bicycles and micromobility devices in use within the community, role within the bicycling network), and land-use context (adjacent land uses, types and intensity of conflicting uses, demands from other users for curbside access). Separated bicycle lanes are recommended on roadways with higher vehicle volumes and speeds, such as arterials.
- City and State policies may require minimum bicycle lane widths, although desirable bicycle lane widths

can differ by agency and functional classification of the road, current and forecasted bicycle volumes, and contextual attributes such as topography.

- Studies have found that roadways did not experience an increase in crashes or congestion when travel lane widths were decreased to add a bicycle lane.⁴
- Studies and experience in U.S. cities show that bicycle lanes increase ridership and may help jurisdictions better manage roadway capacity.
- In rural areas, rumble strips can negatively impact bicyclists' ability to ride if not properly installed. Agencies should consider the dimensions, placement, and offset of rumble strips when adding a bicycle lane.⁵
- Bicycle lanes should be considered on roadways where adjacent land use suggests that trips could be served by varied modes, particularly to meet the safety and travel needs of low-income populations likely to use bicycles to reach essential destinations.⁶

1 Thomas et al. *Bicyclist Crash Types on National, State, and Local Levels: A New Look*. Transportation Research Record 673(6), 664-676, (2019).

2 [Separated Bike Lane Planning and Design Guide](#). FHWA-HEP-15-025, (2015).

3 (CMF ID: [11296](#)) [Developing CMFs for Separated Bicycle Lanes](#). FHWA-HRT-23-025, (2023).

4 Park and Abdel-Aty. *Evaluation of safety effectiveness of multiple cross sectional features on urban arterials*. Accident Analysis and Prevention, Vol. 92, pp. 245-255, (2016).

5 FHWA Tech Advisory [Shoulder and Edge Line Rumble Strips](#), (2011).

6 Sandt et al. [Pursuing Equity in Pedestrian and Bicycle Planning](#). FHWA, (2016).

7 (CMF ID: [10738](#), [10742](#)) [Development of Crash Modification Factors for Bicycle Lane Additions While Reducing Lane and Shoulder Widths](#). FHWA-HRT-21-012, (2021).



Safety Benefits:

RRFBs can reduce crashes up to:

47%

for pedestrian crashes.⁴

RRFBs can increase motorist yielding rates up to:

98%

(varies by speed limit, number of lanes, crossing distance, and time of day).³



RRFBs used at a trail crossing.
Source: LJB

Rectangular Rapid Flashing Beacons (RRFB)

A marked crosswalk or pedestrian warning sign can improve safety for pedestrians crossing the road, but at times may not be sufficient for drivers to visibly locate crossing locations and yield to pedestrians. To enhance pedestrian conspicuity and increase driver awareness at uncontrolled, marked crosswalks, transportation agencies can install a pedestrian actuated Rectangular Rapid Flashing Beacon (RRFB) to accompany a pedestrian warning sign. RRFBs consist of two, rectangular-shaped yellow indications, each with a light-emitting diode (LED)-array-based light source.¹ RRFBs flash with an alternating high frequency when activated to enhance conspicuity of pedestrians at the crossing to drivers.

Transportation agencies should refer to the *Manual on Uniform Traffic Control Devices (MUTCD)* for information on the application of RRFBs.¹

Applications

The RRFB is applicable to many types of pedestrian crossings but is particularly effective at multilane crossings with speed limits less than 40 miles per hour.² Research suggests RRFBs can result in motorist yielding rates as high as 98 percent at marked crosswalks, but varies depending on the location, posted speed limit, pedestrian crossing distance, one- versus two-way road, and the number of travel lanes.³ RRFBs can also accompany school or trail crossing warning signs.

RRFBs are placed on both sides of a crosswalk below the pedestrian crossing sign and above the diagonal downward arrow plaque pointing at the crossing.¹ The flashing pattern can be activated with pushbuttons or passive (e.g., video or infrared) pedestrian detection, and should be unlit when not activated.

Considerations

Agencies should:²

- Install RRFBs in the median rather than the far-side of the roadway if there is a pedestrian refuge or other type of median.
- Use solar-power panels to eliminate the need for a power source.
- Reserve the use of RRFBs for locations with significant pedestrian safety issues, as over-use of RRFB treatments may diminish their effectiveness.

Agencies shall not:²

- Use RRFBs without the presence of a pedestrian, school or trail crossing warning sign.
- Use RRFBs for crosswalks across approaches controlled by YIELD signs, STOP signs, traffic control signals, or pedestrian hybrid beacons, except for the approach or egress from a roundabout.

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and https://highways.dot.gov/sites/fhwa.dot.gov/files/2022-06/techSheet_RRFB_2018.pdf.

¹ Manual on Uniform Traffic Control Devices (MUTCD), Chapter 4L. FHWA, (2023).

² "Rectangular Rapid Flash Beacon" in PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System. FHWA, (2013).

³ Fitzpatrick et al. "Will You Stop for Me? Roadway Design and Traffic Control Device Influences on Drivers Yielding to Pedestrians in a Crosswalk with a Rectangular Rapid-Flashing Beacon." Report No. TTI-CTS-0010. Texas A&M Transportation Institute, (2016).

⁴ (CMF ID: 9024) NCHRP Research Report 841 Development of Crash Modification Factors for Uncontrolled Pedestrian Crossing Treatments, (2017).



Safety Benefits:

13%

reduction in pedestrian-vehicle crashes at intersections.²

Leading Pedestrian Interval

A leading pedestrian interval (LPI) gives pedestrians the opportunity to enter the crosswalk at an intersection 3-7 seconds before vehicles are given a green indication. Pedestrians can better establish their presence in the crosswalk before vehicles have priority to turn right or left.

LPIs provide the following benefits:

- Increased visibility of crossing pedestrians.
- Reduced conflicts between pedestrians and vehicles.
- Increased likelihood of motorists yielding to pedestrians.
- Enhanced safety for pedestrians who may be slower to start into the intersection.

FHWA's Handbook for *Designing Roadways for the Aging Population* recommends the use of the LPI at intersections with high turning vehicle volumes. Transportation agencies should refer to the *Manual on Uniform Traffic Control Devices* for guidance on LPI timing and ensure that pedestrian signals are accessible for all users.¹ Costs for implementing LPIs are very low when only signal timing alteration is required.



An LPI allows a pedestrian to establish a presence in the crosswalk before vehicles are given a green indication. Source: FHWA



LPIs reduce potential conflicts between pedestrians and turning vehicles. Source: FHWA

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/sites/fhwa.dot.gov/files/2022-06/fhwasat19040.pdf>.

¹ Manual on Uniform Traffic Control Devices (MUTCD), Section 4I.06. FHWA, (2023).
² (CMF ID: 9918) Goughnour, E., D. Carter, C. Lyon, B. Persaud, B. Lan, P. Chun, I. Hamilton, and K. Signor. "Safety Evaluation of Protected Left-Turn Phasing and Leading Pedestrian Intervals on Pedestrian Safety." Report No. FHWA-HRT-18-044. Federal Highway Administration. (October 2018)



Safety Benefits:

Median with
Marked Crosswalk

46%

reduction in
pedestrian crashes.²

Pedestrian Refuge
Island

56%

reduction in
pedestrian crashes.²

Medians and Pedestrian Refuge Islands in Urban and Suburban Areas

A **median** is the area between opposing lanes of traffic, excluding turn lanes. Medians in urban and suburban areas can be defined by pavement markings, raised medians, or islands to separate motorized and non-motorized road users.

A **pedestrian refuge island** (or crossing area) is a median with a refuge area that is intended to help protect pedestrians who are crossing a road.

Pedestrian crashes account for approximately 17 percent of all traffic fatalities annually, and 74 percent of these occur at non-intersection locations.¹ For pedestrians to safely cross a roadway, they must estimate vehicle speeds, determine acceptable gaps in traffic based on their walking speed, and predict vehicle paths. Installing a median or pedestrian refuge island can help improve safety by allowing pedestrians to cross one direction of traffic at a time.

Transportation agencies should consider medians or pedestrian refuge islands in curbed sections of urban and suburban multilane

roadways, particularly in areas with a significant mix of pedestrian and vehicle traffic, traffic volumes over 9,000 vehicles per day, and travel speeds 35 mph or greater. Medians/refuge islands should be at least 4-ft wide, but preferably 8 ft for pedestrian comfort. Some example locations that may benefit from medians or pedestrian refuge islands include:

- Mid-block crossings.
- Approaches to multilane intersections.
- Areas near transit stops or other pedestrian-focused sites.



Example of a road with a median and pedestrian refuge islands. Source: City of Charlotte, NC



Median and pedestrian refuge island near a roundabout. Source: www.pedbikeimages.org / Dan Burden

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/sites/fhwa.dot.gov/files/2022-08/techSheetPedRefugeIsland2018.pdf>.

¹ National Center for Statistics and Analysis. (2020, March). Pedestrians: 2018 data (Traffic Safety Facts. Report No. DOT HS 812 850). National Highway Traffic Safety Administration
² (CMF ID: 175) Desktop Reference for Crash Reduction Factors, FHWA-SA-08-011, September 2008, Table 11.



Safety Benefits:

55%

reduction in pedestrian crashes.³

29%

reduction in total crashes.⁴

15%

reduction in fatal and serious injury crashes.⁴

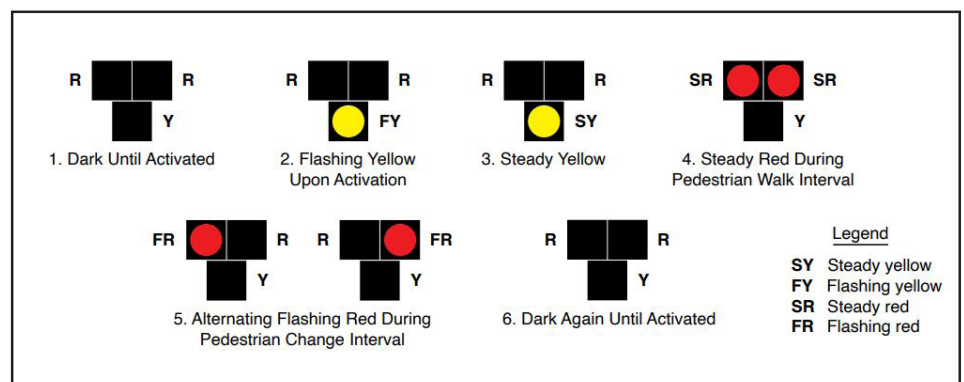


Example of PHBs mounted on a mast arm. Source: FHWA

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/sites/fhwa.dot.gov/files/2022-06/fhwasat18064.pdf>.

Pedestrian Hybrid Beacons

The pedestrian hybrid beacon (PHB) is a traffic control device designed to help pedestrians safely cross higher-speed roadways at midblock crossings and uncontrolled intersections. The beacon head consists of two red lenses above a single yellow lens. The lenses remain “dark” until a pedestrian desiring to cross the street pushes the call button to activate the beacon, which then initiates a yellow to red lighting sequence consisting of flashing and steady lights that directs motorists to slow and come to a stop, and provides the right-of-way to the pedestrian to safely cross the roadway before going dark again.



Sequence for a PHB. Source: MUTCD 2023 Edition, Chapter 4J, FHWA

Nearly 74 percent of pedestrian fatalities occur at non-intersection locations, and vehicle speeds are often a major contributing factor.¹ As a safety strategy to address this pedestrian crash risk, the PHB is an intermediate option between a flashing beacon and a full pedestrian signal because it assigns right of way and provides positive stop control. It also allows motorists to proceed once the pedestrian has cleared their side of the travel lane(s), reducing vehicle delay.

Transportation agencies should refer to the *Manual on Uniform Traffic Control Devices* (MUTCD) for information on the application of PHBs.² Transportation agencies should locate pedestrian signals to be accessible for all users.

In general, PHBs are used where it is difficult for pedestrians to cross a roadway, such as when gaps in traffic are not sufficient or speed limits exceed 35 miles per hour. They are very effective at locations where three or more lanes will be crossed or traffic volumes are above 9,000 annual average daily traffic. Installation of a PHB must also include a marked crosswalk and pedestrian countdown signal. If PHBs are not already familiar to a community, agencies should conduct appropriate education and outreach as part of implementation.

1 National Center for Statistics and Analysis. (2020, March). Pedestrians: 2018 data (Traffic Safety Facts. Report No. DOT HS 812 850). National Highway Traffic Safety Administration

2 Manual on Uniform Traffic Control Devices, Chapter 4J, FHWA, (2023).

3 (CMF ID: 9020) Zegeer et al. NCHRP Report 841: Development of Crash Modification Factors for Uncontrolled Pedestrian Crossing Treatments. TRB, (2017).

4 (CMF ID: 2911, 2917) Fitzpatrick, K. and Park. E.S. Safety Effectiveness of the HAWK Pedestrian Crossing Treatment, FHWA-HRT-10-042, (2010).



Safety Benefits:

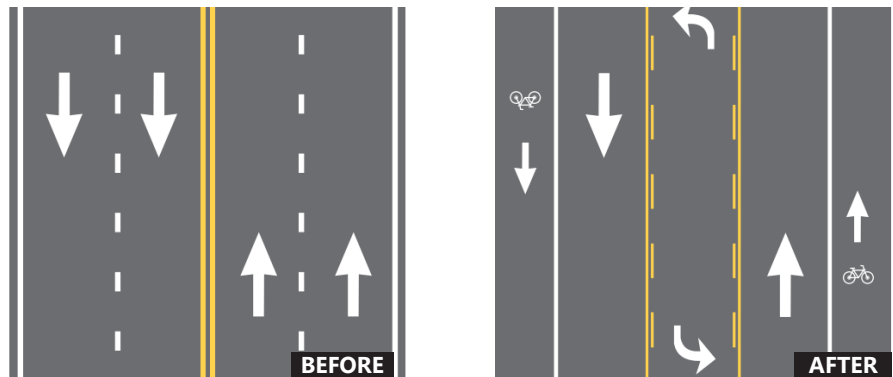
4-Lane to 3-Lane
Road Diet Conversions

19-47%

reduction in total crashes.¹

Road Diets (Roadway Reconfiguration)

A Road Diet, or roadway reconfiguration, can improve safety, calm traffic, provide better mobility and access for all road users, and enhance overall quality of life. A Road Diet typically involves converting an existing four-lane undivided roadway to a three-lane roadway consisting of two through lanes and a center two-way left-turn lane (TWLTL).



Before and after example of a Road Diet. Source: FHWA

Benefits of Road Diet installations may include:

- Reduction of rear-end and left-turn crashes due to the dedicated left-turn lane.
- Reduced right-angle crashes as side street motorists cross three versus four travel lanes.
- Fewer lanes for pedestrians to cross.
- Opportunity to install pedestrian refuge islands, bicycle lanes, on-street parking, or transit stops.
- Traffic calming and more consistent speeds.
- A more community-focused, Complete Streets environment that better accommodates the needs of all road users.



Road Diet project in Honolulu, Hawaii.
Source: Leidos

A Road Diet can be a low-cost safety solution when planned in conjunction with a simple pavement overlay, and the reconfiguration can be accomplished at no additional cost. Typically, a Road Diet is implemented on a roadway with a current and future average daily traffic of 25,000 or less.

¹ (CMF ID: 5554.2841) Evaluation of Lane Reduction "Road Diet" Measures on Crashes, FHWA-HRT-10-053, (2010).

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/safety/other/road-diets>.



Safety Benefits:

Sidewalks

65-89%

reduction in crashes involving pedestrians walking along roadways.³

Paved Shoulders

71%

reduction in crashes involving pedestrians walking along roadways.³

Walkways

A walkway is any type of defined space or pathway for use by a person traveling by foot or using a wheelchair. These may be pedestrian walkways, shared use paths, sidewalks, or roadway shoulders.

With more than 6,200 pedestrian fatalities and 75,000 pedestrian injuries occurring in roadway crashes annually,¹ it is important for transportation agencies to improve conditions and safety for pedestrians and to integrate walkways more fully into the transportation system. Research shows people living in low-income communities are less likely to encounter walkways and other pedestrian-friendly features.²

Well-designed pedestrian walkways, shared use paths, and sidewalks improve the safety and mobility of pedestrians. Pedestrians should have direct and connected network of walking routes to desired destinations without gaps or abrupt changes. In some rural or suburban areas, where these types of walkways are not feasible, roadway shoulders provide an area for pedestrians to walk next to the roadway, although these are not preferable.

Transportation agencies should work towards incorporating pedestrian facilities into all roadway projects

unless exceptional circumstances exist. It is important to provide and maintain accessible walkways along both sides of the road in urban areas, particularly near school zones and transit locations, and where there is a large amount of pedestrian activity. Walkable shoulders should also be considered along both sides of rural highways when routinely used by pedestrians.



Example of a sidewalk in a residential area. Source: pedbikeimages.org / Burden



Paved shoulder used as a walkway. Source: pedbikeimages.org / Burden

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and http://www.pedbikesafe.org/PEDSAFE/countermeasures-detail.cfm?CM_NUM=1.

1 National Center for Statistics and Analysis. (2020, March). Pedestrians: 2018 data (Traffic Safety Facts. Report No. DOT HS 812 850). National Highway Traffic Safety Administration.
2 Gibbs, et al. Income Disparities in Street Features that Encourage Walking. Bridging the Gap, (2012, March).
3 Gan et al. Update of Florida Crash Reduction Factors and Countermeasures to Improve the Development of District Safety Improvement Projects. Florida DOT, (2005).



Safety Benefits:

HFST can reduce crashes up to:

63%

for injury crashes at ramps.²

48%

for injury crashes at horizontal curves.²

20%

for total crashes at intersections.³



Automated application of HFST.
Source: FHWA

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/safety/rwd/keep-vehicles-road/pavement-friction/hfst>.

Pavement Friction Management

Friction is a critical characteristic of a pavement that affects how vehicles interact with the roadway, including the frequency of crashes. Measuring, monitoring, and maintaining pavement friction—especially at locations where vehicles are frequently turning, slowing, and stopping—can prevent many roadway departure, intersection, and pedestrian-related crashes.

Pavement friction treatments, such as High Friction Surface Treatment (HFST), can be better targeted and result in more efficient and effective installations when using continuous pavement friction data along with crash and roadway data.

Continuous Pavement Friction Measurement

Friction data for safety performance is best measured with Continuous Pavement Friction Measurement (CPFM) equipment. Spot friction measurement devices, like locked-wheel skid trailers, cannot safely and accurately collect friction data in curves or intersections, where the pavement polishes more quickly and adequate friction is so much more critical. Without CPFM equipment, agencies will assume the same friction over a mile or more.

CPFM technology measures friction continuously at highway speeds and provides both network and segment level data. Practitioners can analyze the friction, crash, and roadway data to better understand and predict where friction-related crashes will occur to better target locations and more effectively install treatments.¹

High Friction Surface Treatment

HFST consists of a layer of durable, anti-abrasion, and polish-resistant aggregate over a thermosetting polymer resin binder that locks the aggregate in place to restore or enhance friction and skid resistance. Calcined bauxite is the aggregate shown to yield the best results and should be used with HFST applications.

Applications

HFST should be applied in locations with increased friction demand, including:

- Horizontal curves.
- Interchange ramps.
- Intersection approaches.
 - Higher-speed signalized and stop-controlled intersections.
 - Steep downward grades.
- Locations with a history of rear-end, failure to yield, wet-weather, or red-light-running crashes.
- Crosswalk approaches.

Considerations

- HFST is applied on existing pavement, so no new pavement is added.
- If the underlying pavement structure is unstable, then the HFST life cycle may be shortened, resulting in pre-mature failure.
- The automated installation method is preferred as it minimizes issues often associated with manual installation: human error due to fatigue, inadequate binder mixing, improper and uneven binder thickness, delayed aggregate placement, and inadequate aggregate coverage.
- The cost can be reduced when bundling installations at multiple locations.

¹ Izeppi et al. Continuous Friction Measurement Equipment as a Tool for Improving Crash Rate Prediction: A Pilot Study. Virginia Department of Transportation, (2016).

² (CMF ID: [10342_10333](#)) Merritt et al. Development of Crash Modification Factors for High Friction Surface Treatments. FHWA, (2020).

³ (CMF ID: [2259](#)) NCHRP Report 617: Accident Modification Factors for Traffic Engineering and ITS Improvements, (2008).



Safety Benefits:
Lighting can reduce crashes up to:

42%

for nighttime injury pedestrian crashes at intersections.¹

33-38%

for nighttime crashes at rural and urban intersections.^{2,1}

28%

for nighttime injury crashes on rural and urban highways.¹



Source: FHWA

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/safety/other/visibility/roadway-lighting-resources>.

Lighting

The number of fatal crashes occurring in daylight is about the same as those that occur in darkness. However, the nighttime fatality rate is three times the daytime rate because only 25 percent of vehicle miles traveled (VMT) occur at night. At nighttime, vehicles traveling at higher speeds may not have the ability to stop once a hazard or change in the road ahead becomes visible by the headlights. Therefore, lighting can be applied continuously along segments and at spot locations such as intersections and pedestrian crossings in order to reduce the chances of a crash.

Adequate lighting (i.e., at or above minimum acceptable standards) is based on research recommending horizontal and vertical illuminance levels to provide safety benefits to all users of the roadway environment. Adequate lighting can also provide benefits in terms of personal security for pedestrians, wheelchair and other mobility device users, bicyclists, and transit users as they travel along and across roadways.

Applications

Roadway Segments

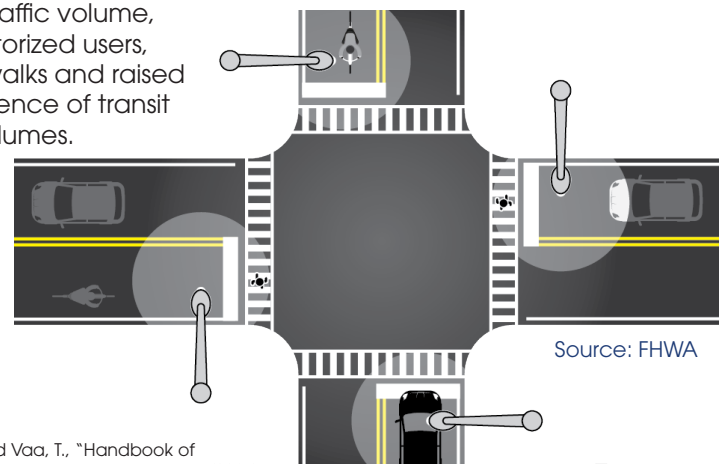
Research indicates that continuous lighting on both rural and urban highways (including freeways) has an established safety benefit for motorized vehicles.¹ Agencies can provide adequate visibility of the roadway and its users through the uniform application of lighting that provides full coverage along the roadway and the strategic placement of lighting where it is needed the most.

Intersections and Pedestrian Crossings

Increased visibility at intersections at nighttime is important since various modes of travel cross paths at these locations. Agencies should consider providing lighting to intersections based on factors such as a history of crashes at nighttime, traffic volume, the volume of non-motorized users, the presence of crosswalks and raised medians, and the presence of transit stops and boarding volumes.

Considerations

Most new lighting installations are made with breakaway features, shielded, or placed far enough from the roadway to reduce the probability and/or severity of fixed-object crashes. Modern lighting technology gives precise control with minimal excessive light affecting the nighttime sky or spilling over to adjacent properties. Agencies can equitably engage with underserved communities to determine where and how new and improved lighting can most benefit the community by considering their priorities, including eliminating crash disparities, connecting to essential neighborhood services, improving active transportation routes, and promoting personal safety.



Source: FHWA

¹ (CMF ID: 436,433,192) Elvik, R. and Vaa, T., "Handbook of Road Safety Measures." Oxford, United Kingdom, Elsevier, (2004).

² (CMF ID: 2376) Ye et al. A Simultaneous Equations Model of Crash Frequency By Collision Type for Rural Intersections, 87th Annual Meeting of the Transportation Research Board, (2008).



Safety Benefits:

Agencies have experienced the following benefits after LRSP implementation:

25%

reduction in county road fatalities in Minnesota.

17%

reduction in fatal and serious injury crashes on county-owned roads in Washington State.

35%

reduction in severe curve crashes in Thurston County, WA.

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/safety/local-rural/local-road-safety-plans>.

Local Road Safety Plans

A local road safety plan (LRSP) provides a framework for identifying, analyzing, and prioritizing roadway safety improvements on local roads. The LRSP development process and content are tailored to local issues and needs. The process results in a prioritized list of issues, risks, actions, and improvements that can be used to reduce fatalities and serious injuries on local roads. FHWA has developed several resources including an LRSP Do-It-Yourself website which further explains the process and includes resources local agencies and their partners need to create and implement an LRSP.¹

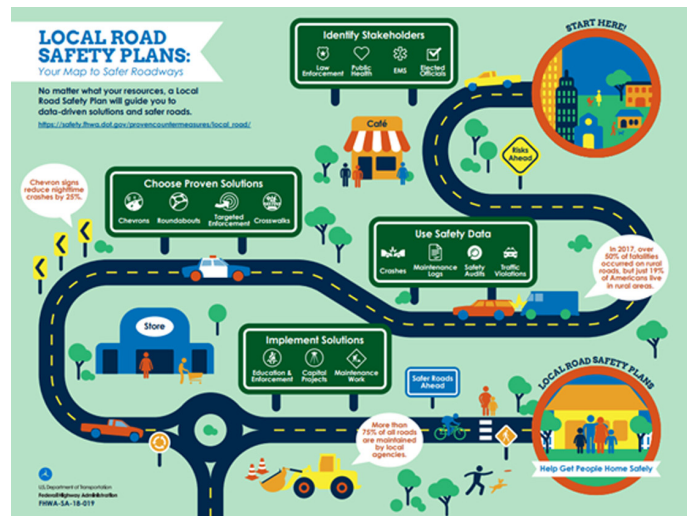
Approximately 75 percent of rural roads are owned by local agencies.² While local roads are less traveled than State highways, they have a much higher rate of fatal and serious injury crashes.² Developing an LRSP is an effective strategy to improve local road safety for all road users and support the goals of a State's overall Strategic Highway Safety Plan (SHSP).

Although the development process and resulting plan can vary depending on the local agency's needs, available resources, and targeted crash types, aspects common to LRSPs include:

- Stakeholder engagement representing the 4E's: engineering, enforcement, education, and emergency medical services.
- Collaboration among municipal, county, Tribal, State, and/or Federal entities to leverage expertise and resources.

- Identification of target crash types and crash risk with corresponding recommended proven safety countermeasures.
- Timeline and goals for implementation and evaluation.

Local road agencies should consider developing an LRSP to be used as a tool for reducing roadway fatalities, injuries, and crashes.³ LRSPs can help agencies create a prioritized list of improvements. LRSPs are also a proactive risk management technique to demonstrate an agency's responsiveness. The plan should be viewed as a living document that can be updated to reflect changing local needs and priorities.



Infographic showing the LRSP process. Source: FHWA

¹ <https://highways.dot.gov/safety/local-rural/local-road-safety-plans>
² Anderson et al. Noteworthy Practices: Addressing Safety on Locally-Owned and Maintained Roads A Domestic Scan, FHWA-SA-09-019, (2010).
³ Developing Safety Plans: A Manual for Local Rural Road Owners, FHWA-SA-12-017, provides guidance on developing an LRSP.



Safety Benefits:



10-60%
reduction in total crashes.¹

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/safety/data-analysis-tools/systemic/road-safety-audits-rsa>.

Road Safety Audit

While most transportation agencies have established traditional safety review procedures, a road safety audit (RSA) or assessment is unique. RSAs are performed by a multidisciplinary team independent of the project. RSAs consider all road users, account for human factors and road user capabilities, are documented in a formal report, and require a formal response from the road owner. (See the eight steps for conducting an RSA below.)

Responsibilities

-  RSA Team
-  Design Team/Project Owner



Source: FHWA

RSAs provide the following benefits:

- Reduced number and severity of crashes due to safer designs.
- Reduced costs resulting from early identification and mitigation of safety issues before projects are built.
- Increased opportunities to integrate multimodal safety strategies and proven safety countermeasures.
- Expanded ability to consider human factors in all facets of design.
- Increased communication and collaboration among safety stakeholders.
- Objective review by independent multidisciplinary team.

RSAs can be performed in any phase of project development, from planning through construction. Agencies may focus RSAs specifically on motorized vehicles, pedestrians, bicyclists, motorcyclists, or a combination of these roadway users. Agencies are encouraged to conduct an RSA at the earliest stage possible, as all roadway design options and alternatives are being explored.



Multidisciplinary team performs field review during an RSA. Source: FHWA

¹ Road Safety Audits: An Evaluation of RSA Programs and Projects, FHWA-SA-12-037; and FHWA Road Safety Audit Guidelines, FHWA-SA-06-06.



<https://highways.dot.gov/safety/proven-safety-countermeasures>

FHWA-SA-21-071



Implementing the Safe System Approach

Strategies to improve pedestrian and bicyclist safety

UC Berkeley
SafeTREC



Funding for this program was provided by a grant from the California Office of Traffic Safety, through the National Highway Traffic Safety Administration.

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Safe System Approach to Road Safety

The Safe System Approach is a framework committed to zero traffic fatalities or serious injuries on our roads. It is human-centered and proactive, focusing on the most vulnerable populations who experience a disproportionate rate of traffic fatalities and serious injuries. The framework focuses on saving lives through the understanding that humans make mistakes and bodies are fragile. The Safe System Approach aims to reduce the kinetic energy generated in a traffic crash through a holistic approach that integrates layers of protection for all road users, thereby minimizing the severity of injuries to the human body. It recognizes that roadway design, management, and investments must prioritize the safety of all road users.

The Community Pedestrian and Bicycle Safety Program (CPBSP) team adapted the Federal Highway Administration's (FHWA) Safe System elements and principles to make them more impactful for grassroots community engagement. The FHWA identifies six key principles within its framework; the CPBSP identifies seven key principles in order to emphasize the need to prioritize equity throughout the system to address persistent disinvestments and institutional biases. We also replaced the FHWA's safe vehicles element with two new elements: capacity strengthening and policies, planning, and safety data. This adaptation reflects the need to engage marginalized communities and invest in active transportation safety.

**Federal Highway Administration
Safe System Approach**



**CPBSP
Safe System Approach**



With our adapted Safe System Approach framework, the CPBSP team:

1. Reviews pedestrian and bicycle crash data and safety strategies;
2. Facilitates walking and biking assessments;
3. Strategizes with participants to define specific community pedestrian and bicycle safety goals and actionable next steps; and
4. Empowers participants to strengthen collaborations in order to implement specific walking and biking safety recommendations in their communities.

Our toolkit aims to help participants create safer communities for walking and biking across California through the use of the Safe System Approach. There are many ways to plan a bikeable and walkable community; this toolkit aims to serve as a starting point.

Within the toolkit, each strategy is organized into key categories and can be easily navigated using the listed keywords. These keywords include:

- **Advocacy and policy:** Actions and plans that aim to garner support for a particular cause, which can be used as a basis for decision-making within different institutions.
- **Data collection and analysis:** Strategies that systematically gather and examine information to discover patterns and relationships in transportation-related data.
- **Infrastructure:** Permanent or temporary structures, systems, and facilities that establish the layout of the roadway.
- **Programming:** An integrated set of planned strategies, activities, and services that address community concerns and promote pedestrian and/or bicycle safety and activity.

Advocacy and policy

Actions and plans that aim to garner support for a particular cause, which can be used as a basis for decision-making within different institutions.

Bicycle and/or pedestrian advisory committee

A volunteer or appointed group of residents, community stakeholders, and subject matter experts that advise and make recommendations to decision-makers on walking and biking programs, projects, and policies.

Example: The [Campbell Bicycle and Pedestrian Advisory Committee](#) holds meetings every other month to discuss pressing bicycle and pedestrian issues, guide the development of planning and policies, and review proposed and planned bicycle- and pedestrian-related projects.

When to use: To provide opportunities for residents, community stakeholders, and subject-matter experts to help shape their community.

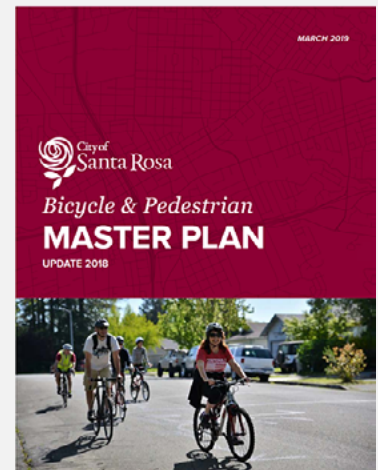


Bicycle and/or pedestrian master plan

An official government document used to guide funding decisions and/or prioritize specific walking and biking improvement programs, projects, and policies.

Example: The [Santa Rosa Bicycle and Pedestrian Master Plan \(BPMP\)](#) is a tool for guiding city staff and the development community in building a transportation system that is pedestrian and bicycle-friendly. It encourages residents to shift from single-occupancy vehicles to active transportation like walking and biking.

When to use: To create a city-wide or regional government plan that prioritizes walking and biking.

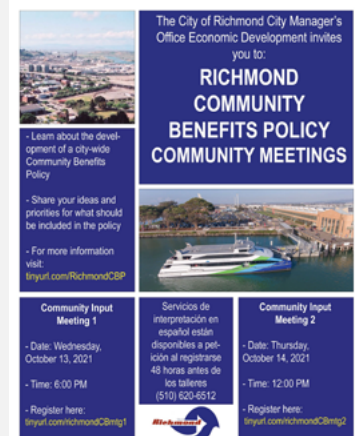


Community benefit agreement

A legally binding contract between a community coalition and the developer of a proposed development project. In exchange for public support of the project, the developer contributes benefits identified by the local community, such as pedestrian and bicycle safety improvements, open green space, affordable housing, and more.

Example: Richmond's City staff members and community members created a [community benefits policy](#) to support community goals in tandem with developments in the city.

When to use: To improve the safety of people walking and biking or increase open green space for the community at or near new development projects.



Community coalition

A variety of partners in a community that work together to improve active transportation safety. This can include work in affordable housing and active transportation, land use solutions, public transportation investments, and more. Coalitions can bring together a large group of advocates and stakeholders (i.e., community residents, local organizations, school representatives, agencies, decision-makers, and others) who combine resources and collaborate towards their shared goals. By taking collective action, members of a coalition can generate increased visibility and have their perspective elevated through a broader effort.

Example: The [South Los Angeles Community Coalition](#) is made up of community residents, youth, service providers, and organizations working together to address inequities and build a better future.

When to use: To provide a well-rounded, safe community for those living in and traveling to it.



Comprehensive safety action plan

A comprehensive safety action plan aims to reduce and eliminate serious injury and fatal traffic crashes affecting all roadway users. This plan uses data analysis to understand roadway safety concerns and strengthen a community's approach through projects and strategies that address the most significant safety risks.

Example: The City of Hawthorne developed a [Comprehensive Safety Action Plan](#) focusing on traffic safety improvements and addressing factors contributing to local traffic collisions.

When to use: To develop a comprehensive strategy to reduce or eliminate serious and fatal traffic crashes on roadways.



Engaged elected official

Engaging a decision maker for walking and biking safety in a community may help bring much-needed support for safety improvements and policies. They can raise awareness and gain public funding support for bicycle and pedestrian projects.

Example: Alongside community members, [Dorothy Wong](#) advocated for and took part in a Community Pedestrian and Bicycle Safety Training workshop in 2018 and has since won funding to implement projects named in the report. Most notably, Dorothy Wong applied for and won an AARP Community Challenge Grant in 2021 to advocate for safe and healthy access to parks which allowed the City to implement a demonstration project at a local park.

When to use: To prioritize biking and walking in a community through the adoption of policies, plans, and laws at the government level.



Funding opportunities that prioritize safety

Local, regional, statewide, and national funding sources identified that can fund traffic safety improvements. This can include Office of Traffic Safety (OTS) grants, Caltrans' Active Transportation Program, local mini-grant opportunities, and more.

Example: The [California OTS](#) provides yearly grants to public entities to address priority program areas including pedestrian and bicycle safety.

When to use: To fund the implementation of walking and biking safety programs and infrastructure projects.

Local Road Safety Plan (LRSP)

A framework and plan that identifies, analyzes, and prioritizes traffic safety improvements on local roads tailored to local issues and needs. The purpose of the plan is to reduce serious injuries and fatalities.

Example: The City of Arcata and Redwood Community Action Agency has developed a [LRSP](#) to analyze and prioritize street safety improvements.

When to use: To identify, analyze, and prioritize traffic safety improvements on local roads, aiming to reduce crashes, injuries, and fatalities by addressing specific traffic safety concerns within the jurisdiction.

Participatory campaign

A campaign that invites the community to participate in the planning process for traffic safety projects and programming, which may include educational safety activities such as mural painting, crosswalk performances, and neighborhood walking, biking, and/or bus tours.

Example: The City of San Francisco’s District Seven has engaged in [participatory budgeting](#), which is a democratic process in which community members propose projects and decide how to spend part of a public budget.

When to use: To provide ways for the community to get directly involved in the planning process for a project and provide their input directly to those planning the project.

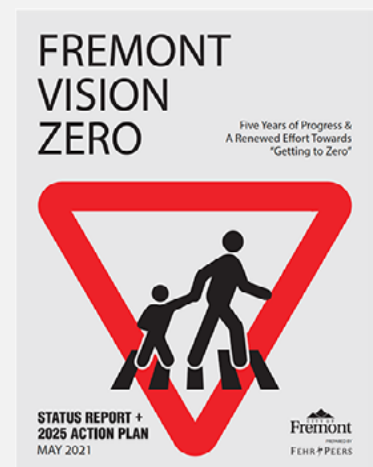


Vision Zero

A policy to eliminate all traffic fatalities and serious injuries on city, county, or state streets. This is accomplished while increasing safe, healthy and equitable mobility for all people using the street but especially vulnerable users. Agencies adopt these policies to signal their priorities to residents, guide future development and decision-making, and demonstrate their commitment to safety.

Example: The City of Fremont has developed a [Vision Zero Action Plan](#) to implement City’s Vision Zero policy of eliminating all traffic fatalities and serious injuries by 2040.

When to use: To encourage more residents to walk, bike, or take transit and improve the safety of vulnerable populations using the corridor. To reach zero deaths and serious injuries within a city, county, or state.



Data collection and analysis

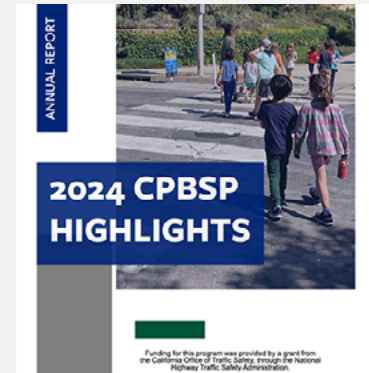
Strategies that systematically gather and examine information to discover patterns and relationships in transportation-related data.

Evaluation

The collection and analysis of data to help make program and funding decisions, as well as understand the impacts of the project or program.

Example: [SafeTREC's 2024 CPBSP Highlight Report](#) provides a high-level summary of the program activities for the CPBSP and its impacts on communities across California.

When to use: To use data to prioritize actions and to track progress related to transportation safety efforts. Evaluation may also support future requests for funding.

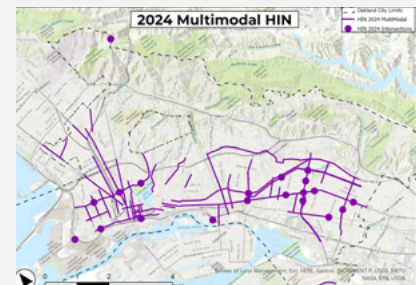


High-Injury Network (HIN)

A data-driven approach to safety that maps fatal and serious crashes to identify streets where the highest concentrations of crashes have occurred. This data can be used to prioritize funding and safety projects in those areas.

Example: The [Oakland High Injury Network \(HIN\)](#) is a map of the corridors and intersections where the most severe and fatal crashes are concentrated, through an analysis of 2017-2021 data.

When to use: To use data to prioritize actions and to track progress related to transportation safety efforts.



Linking crash and medical data

A link between hospital, police, emergency response, and other traffic crash data can provide accurate, coordinated, and timely monitoring of traffic crash injuries and deaths. This data can also be used to support prioritizing traffic safety projects, the evaluation of projects, and monitoring traffic safety projects.

Example: The Injury and Violence Prevention Branch at the California Department of Public Health launched a project to integrate [medical and crash data](#) to better understand how to prevent people from being injured or killed in traffic crashes.

When to use: To use data to prioritize actions and to track progress related to transportation safety efforts.



Pedestrian and bicycle count

A data collection of how many people are walking and/or biking on a street or path to demonstrate the need for more pedestrian and bicycle infrastructure. This can be collected either manually or through automated counters.

Example: In 2016, Long Beach installed its first [pedestrian/bicycle counter](#) that displays daily and annual counts. The counter captures both pedestrians and bicyclists via infrared and inductive loops in real time.

When to use: To collect volume data to demonstrate the need for traffic safety improvements on a street or path or to evaluate how a project has affected multimodal volumes.

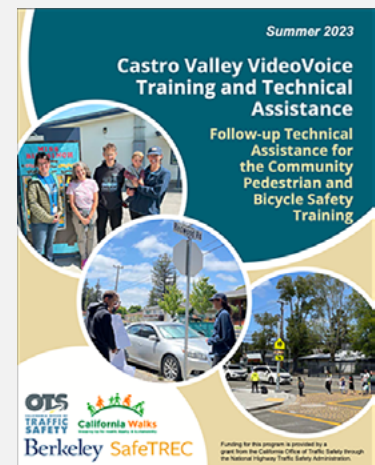


Photo and VideoVoice

The use of images or videos to communicate perspectives and raise awareness of safety issues in a community. Photo and VideoVoice testimonials offer greater flexibility for residents to engage in community planning.

Example: In 2021, SafeTREC's CPBST Project Team worked with the community of Castro Valley on a workshop where the team recommended a [VideoVoice Project](#), one that came to fruition during a technical assistance project in 2023.

When to use: To gather more information and data directly from those impacted by traffic violence, near misses, and unsafe streets in a community. This data can then be used as a tool to advocate for traffic safety improvements.

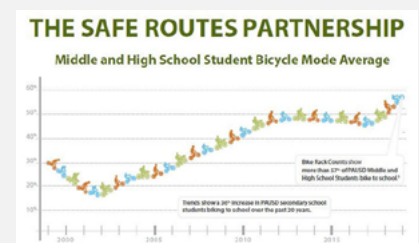


Safe Routes to School (SRTS) data collection

The gathering of information on how students travel to and from school and parents' thoughts about their children walking and biking to and from school. The [National Center for Safe Routes to School](#) offers the Student Travel Tally and Parent Survey forms.

Example: The City of Palo Alto's Office of Transportation has collected [SRTS data](#), ranging from classroom tally data gathered by Palo Alto Unified School District teachers to reported numbers of parked bicycles at each public middle and high school in Palo Alto.

When to use: To better understand how a school currently travels to and from the campus and look to encourage students to walk and bike to school.



Walking or biking assessment

An assessment to identify safety concerns, barriers, and opportunities for key safety improvements, along specific routes in a community. Key safety improvements can include community programs and/or infrastructure projects.

Example: [SafeTREC's Complete Streets Safety Assessment Program](#) offers free technical assistance to communities across California to create safe spaces for people to walk and bike.

When to use: To gather information from residents and others on unsafe conditions on specific streets for people walking and biking. This is a way to gather data to advocate for safety improvements.

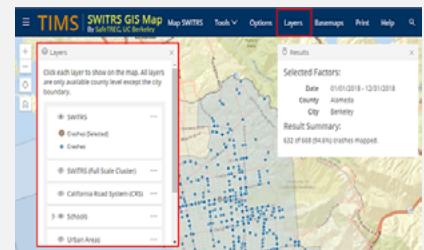


Transportation Injury Mapping System (TIMS)

A web-based tool that allows users to analyze and map crash data from California's crash database (Statewide Integrated Traffic Records System - SWITRS). The [TIMS platform](#) is publicly accessible and free to use.

Example: Elk Grove Unified School District, the fifth largest school district in the state, is using the [TIMS](#) Safe Routes to School Maps Viewer to guide its four-year Safe Routes to School program.

When to use: To use data to prioritize actions and to track progress related to transportation safety efforts.



Infrastructure

Permanent or temporary structures, systems, and facilities that establish the layout of the roadway.

Bicycle infrastructure

Bicycle box

A designated space, usually painted in a high-visibility green paint, where people biking can stop in front of people driving at a red light at an intersection. A bicycle box improves visibility of people biking and encourages more predictable approaches to and through the intersection by all road users. Some bicycle boxes serve as two-stage turn boxes which simplify turn movements and provide a safe place to wait while waiting to complete a turn.

Example: This [bicycle box](#) located in Long Beach gives bicyclists a safe, visible space to wait in front of traffic at a red light.

When to use: To provide a safe place for people biking to stop at a red light and to create predictable road movements.



Bicycle lane

A section of a roadway exclusively for people biking or using another micromobility device¹, which reduces conflicts between people walking, biking, and driving. Colored pavement, striping, signage, and other pavement markings may be used to increase visibility.²



*Protected bicycle lane
(Class 4)*

¹ A micromobility device includes any small, low-speed, human or electric-powered transportation device, including bicycles, scooters, electric-assist bicycles (e-bicycles), electric scooters (e-scooters), and other small, lightweight, wheeled conveyances. https://www.fhwa.dot.gov/livability/fact_sheets/mm_fact_sheet.cfm

² Regulations vary by city and/or county for where and how different types of micromobility devices are allowed to operate.

Bicycle lane, continued

There are different types of bicycle lanes:

- [Protected bicycle lanes](#) (also known as separated bicycle lanes and cycletracks): These are physically separated from vehicle travel lanes using features such as bollards, jersey barriers, curbs, planters, or parked cars. They offer the highest level of security and safety for all road users.
- [Buffered bicycle lanes](#): These are separated from vehicle lanes with a painted buffered space alongside the conventional bicycle lane, providing additional space and safety.
- [Conventional bicycle lanes](#): These are separated from vehicle lanes, and typically striped with white paint and located on the right side of a road.
- [Bicycle boulevards](#): Shared roads that prioritize bicycle travel, typically marked with painted white sharrows, to indicate to all road users to share the space.

Example: The City of Berkeley has implemented seven [bicycle boulevards](#) to encourage biking and discourage through traffic on smaller, residential streets. These streets have been identified as optimal routes for bicyclists.

When to use: To provide safer, more comfortable roads for people biking or using another micromobility device in the community. Bicycle lanes separate people biking from people driving, reducing the risk of serious injuries in the event of a crash due to differences in their driving speeds. This helps all road users navigate the road predictably and safely. Oftentimes, they also improve the safety of people walking along the corridor.



*Buffered bicycle lane
(Class 2B)*



*Conventional bicycle lane
(Class 2)*



*Bicycle boulevards
(Class 3, or Class 3B)*

Bicycle parking

A designated location for bicycles and other micromobility devices to be safely stored, including bicycle corrals, bicycle racks, bicycle lockers, bicycle stations, and other parking options. They encourage people to bike or roll to their destinations because they have a safe place to store them.

Example: Three Bay Area Rapid Transit (BART) stations in Oakland operate [bicycle stations](#) to secure BART users' bicycles to incentivize multimodal transportation.

When to use: To encourage more people to bike or roll by providing them with safe ways to park bicycles or micromobility devices at their destinations.



Bicycle sensor/detector

A sensor or detector that captures when a bicycle or other micromobility user passes over it to trigger the traffic light. Most commonly, they are either video detectors or in-pavement sensors. In-pavement sensors are often paired with road markings to let people biking know where to position themselves at an intersection to activate the traffic signal via the sensor or detector.

Example: The City of Danville has installed [bicycle detection cameras](#) at key intersections to improve bicyclist safety and signal responsiveness. These video detection systems accurately recognize bicycles and trigger traffic signals, replacing magnetic sensors. A green bicycle sign with a blue light confirms with the bicyclist that they have been detected. So far, 15 systems have been installed at seven major intersections.

When to use: To prioritize people biking or rolling along a roadway and to create a safe, accessible path of travel.



Bicycle signal

A traffic signal that directs people biking or rolling through an intersection and reduces potential conflict with other road users like people walking or driving.

Example: A [bicycle signal](#) located in the City of Monterey accommodates increased bicycle and pedestrian traffic along a major road. The bicycle signals are coordinated with traffic signals so that bicycles can safely enter and exit the median bicycle lanes.

When to use: To provide dedicated signals for people biking or rolling, especially on corridors with protected bicycle lanes. By separating their movements from people driving and people walking, the movement of people biking and rolling is more predictable which improves their safety.



Public bicycle repair station

A station that houses tools to perform basic bicycle repairs and maintenance, such as inflating a flat tire or adjusting brakes, to support safer biking.

Example: The Los Angeles Department of Transportation (LADOT) works with local businesses and community groups to set up [bicycle repair stations](#) around Los Angeles. These stations help bicyclists fix their bicycles with tools like wrenches, screwdrivers, and a bicycle pump.

When to use: To provide free access to tools for people biking in the community, regardless of their economic status. They also help improve the safety of people biking by providing regular access to bicycle tools to make sure their bicycles are safe to ride.



Green infrastructure

Median gardening

The addition of trees and landscaping to medians to provide aesthetic benefits and traffic calming.

Example: The [City of La Palma](#) contracted a landscape designer to create a modern, drought-tolerant median design with the goals of reducing water usage, improving visual appeal, and implementing a consistent design throughout the city.

When to use: To calm traffic and add greenery to communities.



Permeable sidewalk/pavement

Sidewalk or pavement that allows stormwater to filter through to the soil below. Since water seeps through the pavement, puddles and ice will not form on the road which improves safety for people walking, biking, or driving.

Example: The City of Santa Barbara has installed [permeable pavement](#) at city-owned parking lots, sidewalks, streets, alleys, and parks, in order to allow stormwater and urban runoff to filter into the ground below.

When to use: To manage stormwater on low-traffic roads and provide safe road conditions for people walking, biking, or driving.



Rain garden

A landscaping feature designed to reduce flooding along a street. They can be installed along with bulbouts to make an area more inviting to walk and bike. They can help manage stormwater, add greenery to a corridor, and replace concrete curb extensions to provide an aesthetic alternative.

Example: In 2023, the City of Lafayette opened its first [rain garden](#). Their rain garden collects, filters, and absorbs stormwater runoff.

When to use: To calm traffic along a corridor, while managing stormwater, and provide an aesthetic green element for the street.



Shade tree

A tree that provides shade and decreases noise pollution, which improves a street's walkability and bikeability, and supports mental well-being in a community

Example: The [Sacramento Shade program](#) has planted more than 600,000 shade trees in the Sacramento area and has recently expanded both the number and types of trees offered. Currently, the program offers up to 10 free trees per customer and over 30 varieties to choose from.

When to use: To provide a comfortable environment for people walking, slow traffic, manage stormwater, and other community improvements.



Sidewalk landscaping

The conversion of a concrete sidewalk space into a landscaped area. It can include native plants and other neighborhood improvements like rain gardens.

Example: San Francisco Public Works issues low-cost permits for [sidewalk landscaping](#) so property owners can convert a portion of their sidewalk into an attractive landscaped area. These sidewalk improvements provide wildlife habitats, reduce flooding, and increase property values.

When to use: To enhance existing sidewalks and add greenery to communities.



Pedestrian infrastructure

Curb ramp

A ramp that provides safer access between the sidewalk and roadway for people, especially those using wheelchairs and other assistive mobility devices. Without curb ramps, people with mobility disabilities are often forced to travel in the street alongside traffic. Curb ramps also provide benefits to those using strollers, bicycles, or anyone else who may have trouble stepping up and down from curbs. Curb ramps should include truncated domes (also known as tactile paving) which serve as a detectable warning that can be seen, felt, and heard.

Example: The City of San Francisco improved pedestrian access at the intersection of Sotelo Avenue and Lopez Avenue. The project involved redesigning and rebuilding four [curb ramps](#) to meet safety and accessibility standards.



When to use: To create roads and sidewalks that are accessible and safe to use for all people using the road, especially people with disabilities. It is often difficult, or even impossible, for a person using a wheelchair or other assistive mobility device to cross a street if the sidewalk on either side of the street ends without a curb ramp. Curb ramps must be provided in order for people of all ages and abilities to have equal access to public spaces.

Pedestrian head start (leading pedestrian interval)

A traffic signal that gives people walking a three to seven seconds head start to enter an intersection before people driving receive a green light. This improves the visibility of people walking in the intersection and highlights their right-of-way over turning vehicles. The National Manual on Uniform Traffic Control Devices (MUTCD) recommends a pedestrian crossing speed of 3.5 feet per second. California's MUTCD recommends 2.8 feet per second where people with disabilities or seniors walk. This allows vulnerable populations, like school children or older adults, more time to cross the street safely.

Example: As of 2022, intersections operated by the State of California must program the signal to give pedestrians a three to seven second head start before the light turns green for vehicle traffic moving in the same direction, according to AB 2264.

When to use: To increase the safety of people walking by allowing them a head start to cross at an intersection, which also increases their visibility to people driving.



Pedestrian lane

A defined space on the roadway for people walking which can be implemented on one or both sides. The lane is a temporary pedestrian facility usually placed on roads with low to moderate speeds and volumes.

Example: The City of Detroit, Oregon has implemented a separated [pedestrian lane](#) that also accommodates bicycles, providing a designated space for pedestrians within the roadway.

When to use: To provide a space for people walking on roads with low to moderate speeds and volumes.



Pedestrian zones

A section of a roadway exclusively for people walking, which reduces conflicts between people walking, biking, and driving. Pedestrian zones can be either permanently, periodically, or occasionally closed to vehicular traffic. Colored pavement, striping, signage, greenery, and other elements may be used to create these spaces.

There are different types of pedestrian-only spaces:

- [Pedestrian plaza](#): A pedestrian-only plaza repurposes an underutilized street, alley, or other community space. It improves the safety of those walking and provides more green space that can incorporate elements like benches, tables, greenery, and bicycle racks.
- [Pedestrian street \(pedestrian mall\)](#): A pedestrian street is a pedestrian space created on what used to be a vehicular street and is typically in larger, urban areas where there are high volumes of pedestrian traffic and ample shopping, eating, and other local destinations along the corridor. The space provides opportunities for dining outside, gathering, and other social activities.

Example: The City of Gilroy launched their [Gourmet Alley](#) Project to transform an alley into a public pedestrian plaza. This alley was converted into two blocks of newly-paved, pedestrian-only space, lined with trees, public seating, planters, and lighting.

When to use: To provide more open spaces for people walking and create more green space in a community.



Pedestrian plaza



Pedestrian street

Pedestrian safety island (pedestrian refuge island)

A designated area in the middle of a crosswalk where people walking can stop and rest between light signals. Typically housed within a median made of concrete, pedestrian safety islands may also feature high-visibility road striping and signage for added safety.

Example: The City of San Francisco has installed [pedestrian refuge islands](#) in the middle of Market Street to create safer conditions for pedestrians crossing the street, alongside other traffic calming measures.

When to use: To create safe places of refuge for people walking across wide, multi-lane roads where people walking have trouble crossing due to high volumes of traffic or long crossing distances. These can also be used in areas where there's a large presence of vulnerable road users like school children or older adults.



Pedestrian-scale lighting

Lighting that is positioned towards sidewalks and pedestrian paths, typically located closer to the ground, and installed closer together to improve the walking experience.

Example: The City of Oakland's [International Boulevard Pedestrian Lighting and Sidewalk Improvement Project](#) installed pedestrian-scale lighting and repaired sidewalks to provide safer pedestrian conditions for people along International Boulevard. These improvements aim to improve pedestrian travel, encourage transit ridership, and provide health and environmental benefits.

When to use: To provide sufficient lighting for people walking and improve sightlines for people walking, biking, or driving at night. It can also provide a sense of safety on previously dark roads that people may have avoided walking on at night.



Pedestrian scramble

An intersection that stops driver traffic in all directions and allows people walking to simultaneously cross in all directions of the intersection, including diagonally. This allows people to cross the street without having to worry about potential conflicts with those driving who are turning right on a red light.

Example: The City of Santa Monica has [pedestrian scrambles](#) operating throughout its downtown, giving pedestrians exclusive access to the intersection.

When to use: To provide safety improvements for people walking at intersections with a large volume of people walking. These are oftentimes used in downtown city corridors where people walking often outnumber people driving.



Raised crosswalk

A type of speed table that brings the roadway to the same level as the sidewalk. It allows people to cross without a curb ramp and makes people walking in the crosswalk more visible to people driving. Raised crosswalks can be located at intersections or mid-block. At intersection locations, the raised area can be extended to include the entire intersection.

Example: As part of San Francisco Municipal Transportation Agency's Wiggle Neighborhood Green Corridor Project, [raised crosswalks](#) were installed to further highlight pedestrian crossings and encourage safe speeds through intersections.

When to use: To physically encourage people driving to slow down before passing over the crosswalk, yield to pedestrians, and provide a level path from curb to curb for people walking.



Sidewalk

A separate, designated place for those walking outside of the road. Typically, they are installed in urban areas and have a minimum width of six feet with sufficient lighting, shade, and level surfaces.

Example: A physically separated [sidewalk](#) in Los Molinos was installed during a safety enhancement project on the main street for Los Molinos by Caltrans District 2.

When to use: To make roads accessible to all ages and abilities, especially for residents with disabilities, and in areas where people walking are forced to travel in the street due to insufficient or missing sidewalks.



Traffic safety infrastructure

Complete Streets

Streets that are designed to provide a safe, comfortable space for all people using the street, regardless of age or ability. Complete Streets policies are set at the state, regional, and local levels and are frequently supported by roadway design guidelines.

Example: California Department of Transportation (Caltrans) created a [Complete Streets Elements Toolbox 3.0](#) that translates complex statewide policies into concepts and practices for project delivery purposes aimed at more effective Complete Streets implementation. The Toolbox provides guidance to assist project staff-planners, project managers, engineers, designers, etc., in the selection of Complete Streets elements to meet relevant goals and objectives in Caltrans' Strategic Management Plan, Complete Streets policy (DP-37).

When to use: To encourage more residents to walk, bike, or take transit, and improve the safety of vulnerable populations using the corridor.



Curb extension (bulb-out)

An extension of the sidewalk in order to narrow the roadway, slow driver speed, and shorten crossing distances for pedestrians. They can be used at corners or mid-block and can be built with paint, bollards, or planters. Curb extensions can often be lengthened to create public spaces, landscaped areas, or transit waiting areas.

Example: San Francisco Municipal Transit Agency implemented three new [bulb-outs](#) throughout the city to shorten crossing distances, improve visibility, and encourage drivers to slow down.

When to use: To increase the visibility of people walking at intersections, shorten crossing distances, reduce turn speeds of those driving, increase sidewalk space for people walking, provide additional public space, reduce illegal parking at corners, crosswalks and bus stops, and provide the space needed to install curb ramps.

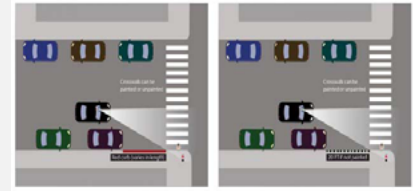


Daylighting

The practice of pushing parking spaces at least 15 to 20 feet back from a pedestrian crossing, which increases the visibility between people walking or biking and those driving, which in turn reduces conflicts.

When to use: To increase the safety of people walking or biking along a corridor and improve the visibility between them and those driving.

Example: As of 2025, daylighting is a law ([AB 413](#)) in California. This law prohibits a person from parking a vehicle within 20 feet of either side of any marked or unmarked crosswalk, or within 15 feet of any crosswalk where a curb extension is present.



High-visibility road striping and signage

Road striping and signage that is installed to emphasize or indicate designated space and safety messaging for particular road users and help them detect each others' location on the road. The high-visibility striping and signage also increase visibility at night or in low-light conditions because the paint used for striping and materials used to create signs reflect back the light source. For example, when a car's headlights reach high-visibility road striping, the light will reflect back at the driver.

Example: The City of San Rafael has installed [high-visibility](#) crosswalks, added red curbs at intersections in a practice known as 'daylighting' for visibility, and has added pedestrian crossing signage at uncontrolled crossings.

When to use: To emphasize or indicate where each road user should be on the road, especially at night when regular paint alone is hard to see.



Multi-use trail/Shared path

A separated off-road space for people walking and biking. Some multi-use trails may even separate people biking and walking into their own lanes. These are most commonly implemented along rivers, shorelines, canals, utility rights-of-way, railroad rights-of-way, within school campuses, or within and between parks.

Example: Sonoma County Regional Parks implemented nine [Class 1 Multi-Use Trails](#) designed to accommodate many types of users.

When to use: To provide safe, off-road paths for people walking and biking in the community, especially near parks and other green spaces.



Neighborhood traffic circle (mini roundabout)

A small raised circular island in a residential intersection that directs traffic to flow in one direction. These are smaller than roundabouts and are intended to keep speeds as low as possible while also improving the safety of pedestrians.

Example: The [City of East Palo Alto](#) installed two temporary traffic circles at intersections on Pulgas Avenue near schools to calm traffic and improve safety for students walking and biking. The goal is to convert these temporary traffic circles into permanent mini roundabouts to reduce collisions, injuries, and vehicle emissions, while making travel safer for both students and local residents.

When to use: To reduce the speeds of people driving through neighborhoods and improve the safety of those walking.

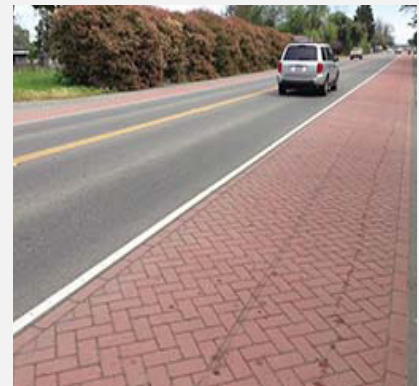


Paved shoulder

A functional space for people walking and biking on the edge of a roadway where there is an absence of other infrastructure like bicycle lanes or sidewalks, typically in rural communities.

Example: The community of Capay has implemented a visually separated [paved shoulder](#) using colored and stamped asphalt designed to mimic bricks. This design choice emphasizes pedestrian space while maintaining roadway efficiency, improving visibility and safety for those walking along the corridor. The project was developed with input from Alta Planning + Design.

When to use: To provide space for people walking and biking on roads that lack other facilities, sidewalks or bicycle lanes.



Pedestrian hybrid beacon (high-intensity activated crosswalk [HAWK] beacon)

A marked crossing signal with flashing lights that are activated by push signals to help pedestrians safely cross the street. The beacon alerts people driving to stop at an intersection or mid-block crosswalk for a pedestrian and brings more visibility to those crossing the road.

Example: The City of El Cerrito has implemented a pedestrian [hybrid beacon](#) along a busy intersection to make crossing safer for pedestrians by reducing pedestrian-vehicle conflicts.

When to use: To increase the safety of people crossing major streets where side-street volumes do not support the installation of a conventional traffic signal and to increase the safety of people walking by signaling those driving to stop so people walking can safely cross the street.



Protected intersection

The physical separation and protection of people walking, biking, and rolling at and in intersections. They can include posts, bollards, concrete, or other infrastructure. Bicycle crossings are placed next to, but separated from, pedestrian crossings to minimize potential conflicts between those walking and biking as well.

Example: The City of San Luis Obispo launched its first [protected intersection](#) in 2021 to increase safety for those walking, biking, and rolling.

When to use: To improve the safety of people walking or biking at and in intersections with a history of collisions. They can also facilitate left turns for people biking by providing a waiting area to complete the crossing in two stages.



Quick-build project

A semi-permanent project that can be implemented quickly to prioritize the safety of those using the street. Oftentimes, they are intended to test improvements and can undergo changes after installation to make them more impactful. They can be completed with as little as paint and posts, but can include concrete and other more permanent elements. They can be planned rapidly and installed roughly within a year of planning.

Example: San Francisco has completed 40 [quick-build projects](#) with many additional quick-build projects on the way. These safety improvement projects are constructed within weeks or months and are reversible and adjustable.

When to use: To create impactful, money-saving safety projects. Quick-builds are a tool that can improve the safety of a street for a margin of what a full project would cost. They can be used as a way to test out a project or new infrastructure element before committing to it fully.



Rectangular rapid flashing beacon (RRFB)

Flashing signals that are activated by a button by people walking at a crosswalk. The rectangular rapid flashing beacons also typically include high-visibility striping and signage that improves the safety of those walking and cues people driving to yield for pedestrians. They are particularly effective for crossing multi-lane streets with speed limits of less than 50 mph.

Example: The City of Fremont added [rectangular rapid flashing beacons](#) at Dorne Place and Mento Drive as part of the Paseo Padre Parkway Improvements Project. These RRFBs provide a high-visibility strobe-like warning to drivers when pedestrians use an uncontrolled crosswalk.

When to use: To increase the safety of people walking by encouraging those driving to yield to pedestrians at a crosswalk.

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Reduced speed limit zone

Designated areas with a decreased speed limit of 25, 20, or 15 miles per hour (mph), typically near schools, senior zones, or commercial corridors. The reduced speed limits prioritize the safety of those walking and biking in the area, especially those most vulnerable to traffic crashes like seniors and school kids.

Example: The City of San Mateo has implemented [reduced speed limit zones](#) near schools. To ensure a safe environment for students, speed limits around schools have been lowered to 15 and 25 mph.

When to use: To reduce the speed of people driving and improve the safety of people walking and biking.

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Road rightsizing (road or traffic diet)

Road rightsizing typically involves the conversion of an existing four-lane, undivided roadway into a three-lane roadway. This can allow the newly reclaimed space to be used as bus lanes, bicycle lanes, sidewalks, or other uses. It can also reduce the speed of people driving which makes it safer for people who walk and bike along the corridor.

Example: The [California Street Road Diet Project in Stockton](#) reduces lanes from four to two, adding a center turn lane, bicycle lanes, and pedestrian improvements to enhance safety. The project, which began in October 2023, includes ADA-compliant sidewalks, upgraded traffic signals, and a high-visibility crosswalk near medical facilities.

When to use: To provide more street space for people walking, biking, or taking transit. It also reduces vehicle speeds along a corridor.



Roundabout

A circular island in an intersection that directs high-volume traffic to slow down and yield before entering the intersection. Roundabouts are an alternative to traffic signals and are designed for roads with speeds greater than 25 mph.

Example: The City of Burlingame completed a [roundabout](#) project at a complicated intersection. The roundabout implements traffic calming measures by slowing down motorists, clarifying right-of-way for various movements of traffic and prioritizing pedestrian and bicycle safety.

When to use: To promote slower speeds in an intersection. To reduce T-bone and head-on crashes which typically result in more serious injuries.



Slow Streets

The reduction of through vehicle traffic on low-volume and low-moderate speed streets with temporary signage and barriers aimed to create a shared space for people walking and biking.

Example: The City of Oakland's Department of Transportation developed a network of [Slow Streets](#) to promote sustainable transportation and to encourage the use of neighborhood streets as community spaces.

When to use: To create cost-effective ways to lower the speed of people driving and create safer, more comfortable routes for people walking and biking.



Temporary demonstration project

A project that installs short-term safety enhancements that allow community residents to experience and give feedback on a project before it is permanently installed. They differ from quick-build projects because they are installed before a decision is made by the local government body. They provide a way to test out potential projects before voting on making them permanent.

Example: The City of East Palo Alto launched a [temporary demonstration project](#) involving the installation of temporary traffic circles at two intersections of concern in the city near schools.

When to use: To create a way to test out a potential project, provide residents a tangible way to experience the potential changes, and gather community feedback on the project before permanently installing it.



Vertical speed control elements

Vertical speed control elements help manage and reduce vehicle speeds due to the increased height of the street. They are typically implemented on neighborhood, residential, and low-speed corridors.

There are different types of vertical speed control elements:

- **Speed hump:** A piece of raised pavement in the roadway, approximately 3 to 4 inches high at its center and 12–14 feet wide which extends the full width of the street to slow vehicle speeds. These can also act as raised crosswalks in certain instances. Oftentimes, speed humps are referred to as speed bumps but the two are different. A speed bump is much shorter, between 1 to 2 feet in length and as high as 6 inches in height. They are typically found in parking lots and not on public roads.
- **Speed table:** A midblock traffic calming device that raises the entire wheelbase of a vehicle to reduce its traffic speed. They are 3-3.5 inches high and 22 feet wide, with a flat top. These can also act as raised midblock crosswalks in certain instances.
- **Speed cushion:** Either speed humps or speed tables used on corridors that also act as major emergency access routes. They include wheel cutouts to allow emergency vehicles like fire trucks to pass unaffected.

Example: The [Oxnard Speed Hump Program](#) allows residents to request the City install stop signs and/or speed humps to combat speeding on streets. Approvals of speed hump and/or stop sign requests vary by case, depending on the corridor's current condition. Certain corridors may need an Engineering and Traffic Study (E&TS) and/or community support of the infrastructure in the form of a circulated petition, and all requests are subject to a ranking/scoring system.

When to use: To reduce the speed of people driving and improve the safety of people walking and biking.



Speed hump



Speed table



Speed cushion

Wayfinding

A system of signage and pavement markings that guide people walking and biking to popular community destinations. Wayfinding tells someone walking or biking the distance or the time it will take to walk or bike to a destination.

Example: The City of Berkeley designated a grid of traffic-calmed streets as bicycle boulevards and added a comprehensive signage system that enables citywide point-to-point [wayfinding](#), with connections to schools, parks and transit.

When to use: To make navigating for people walking and biking as easy as possible. Wayfinding can also encourage walking and biking because navigating the community is easier for those new to walking or biking.



Programming

An integrated set of planned strategies, activities, and services that address community concerns and promote pedestrian and/or bicycle safety and activity.

Bicycle programming

Bicycle rodeo

A bicycle rodeo is an on-bicycle education event, typically for youth, to teach them the skills needed to ride a bicycle safely. They can include bicycle safety inspections, helmet and other safety gear distribution to those in need, and teaching bicycle maintenance skills and the rules of the road. They can also include scooters, skateboards, roller skates, and other forms of micromobility.

Example: Solano County's Safe Routes to School Program organizes [bicycle rodeos](#) to teach youth how to safely use the road as a pedestrian, bicyclist, and scooter rider.

When to use: To encourage school children to bike or roll to school and educate them on how to do so safely.



Bicycle safety diversion program

A sponsored program by a local law enforcement agency that offers bicycle traffic school to remove or reduce a traffic violation fine for people who bike. Attendees learn bicycle laws and safe riding skills.

Example: [The Bicycle Safety Diversion Program](#), run by [Active SGV](#), allows bicyclists ticketed for minor infractions to take a free bicycle education class instead of paying a fine. The program, available in multiple languages, teaches bicycle laws and safe street riding to improve bicyclist safety and provide a fairer alternative to fines or jail time. The City of Bakersfield offers a monthly [bicycle court diversion program](#) for youth cited for bicycle-related violations instead of formal court proceedings.

When to use: To provide a way for people who bike to remove or reduce a traffic violation fine, similar to what is already provided for those who drive.



Bicycle train

A group of students who bike or roll to school accompanied by an adult along a designated route. Students can join the bicycle train along any of several identified stops and oftentimes bicycle trains include those on scooters, skateboards, and other micromobility devices.

Example: Sonoma County's Safe Routes to School program organizes [bicycle trains](#) to encourage safe group bicycle rides to schools.

When to use: To encourage more students to bike or roll to school, improve their safety, and involve students and parents directly in Safe Routes to School work.



Earn-A-Bicycle program

A program that offers community members, typically youth, the opportunity to earn a bicycle by participating in classes that teach them the rules of the road, bicycle safety, and basic bicycle mechanic skills.

Example: [Trips for Kids Earn-A-Bike program](#) an online month-long course that provides youth with the opportunity to learn bicycle mechanics, bicycle safety and earn their own bicycle.

When to use: To provide more equitable access to bicycles, given that not every resident can afford one.



Helmet/light distribution

Helmet and bicycle light distribution to residents in need to prioritize their safety and visibility. They typically run in conjunction with bicycle education to promote helmet use to prevent head injuries and encourage safe riding.

Example: [UC Santa Cruz Transportation and Parking Services](#) offers free bicycle helmets to all students, staff, and faculty.

When to use: To provide more equitable access to helmets and bicycle lights, which greatly improve the safety of people biking.



Community safety programming

Community liaison/promotores program

Community liaisons and promotores help bridge the gap between local residents and traffic safety agencies and stakeholders. In addition to building trust among members of their community as well as across partners, they may promote education, increase awareness of community safety concerns, and/or advocate for changes to improve road safety. They can help strengthen and build coalitions while also ensuring that projects and programs are culturally appropriate.

Example: The Safe Street Community Promotora Educators at [Los Angeles Walks](#) advocate for secure safe street infrastructure and host local workshops for neighborhood residents. The program envisions a city where community residents with lived experiences are the ones creating community design and equitably compensated for their work.

When to use: To promote safe walking and biking in communities by teaching and uplifting community members as their own advocates.



Community walk or bicycle ride

An event that encourages residents to walk or bike together and may explore local themes, such as art, music, history, and architecture.

Example: [Monroe Practice Days](#), a program that serves San Francisco's southeast neighborhoods, empowers the community through free bicycle education and resources. In partnership with Monroe Elementary, local groups, and non-profits like YBike, the program distributes bicycles, helmets, and u-locks, while offering multilingual bicycle instruction.

When to use: To encourage more residents to walk or bike. This can be a more comfortable introduction to walking or biking in the community for those with no experience.

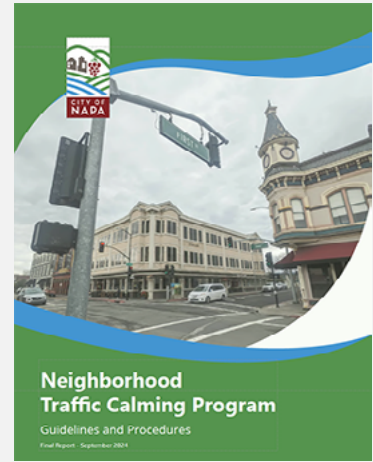


Neighborhood speed awareness program

The use of radar trailers and changeable message sign boards to make people driving aware of their speed and encourage them to adhere to the posted speed limit.

Example: The City of Napa's Neighborhood Traffic Calming Program (NTCP) aims to reduce speeding and cut-through traffic on local streets with speed limits of 35 miles per hour or less by installing [speed signs](#) to help control traffic flow and improve safety.

When to use: To increase traffic safety awareness and lower speeds along specific streets.



Open streets

A temporary closure of streets to vehicle traffic which opens them to people walking, biking, and participating in other social activities.

Example: Morgan Hill held an [open street event](#) by closing the road to vehicle traffic, allowing residents to enjoy activities and entertainment along the road.

When to use: To create temporary closures on community streets to provide a safe, more comfortable place for people walking and biking.



Parklet

A sidewalk extension that provides public space to anyone in the community. Parklets may include benches, tables, greenery, bicycle racks, and more. They also provide space for people to sit and enjoy the space next to restaurants and other businesses. They may provide traffic calming effects to the corridor as well.

Example: The City of Richmond piloted a [parklet program](#) to repurpose and activate public space innovatively, repurposing road space for all users.

When to use: To provide more open space for residents, including spaces for sitting, eating, and bicycle parking. They widen sidewalks and can also slow traffic by taking a portion of the roadway.



Placemaking

An approach that deeply engages the arts, culture, and creativity — especially from underrepresented communities — in planning and designing public spaces so that the resulting communities better reflect and celebrate local culture, heritage and values.

Example: [San Diego's Quartyard in East Village](#) was redesigned as an eco-friendly outdoor community space made from repurposed shipping containers. Through these placemaking improvements, the Quartyard now thrives as a social spot, with a beer garden, a restaurant, a music venue, and a dog park.

When to use: To get residents directly involved with improvements in their community and ensure any changes align with their vision for the community.



Provide rapid response

Physical and emotional care to crash survivors and their families. It can provide a way to get planners in the community to reassess key intersections or streets for safety improvements.

Example: Families for Safe Streets has composed a [post-crash resource guide](#) for those who have lost a loved one or have been seriously injured in a traffic crash, or for those who are providing support to someone affected by a traffic crash.

When to use: To support those impacted by a traffic crash and the families who have lost a loved one to traffic violence.



Safety messaging campaign

A campaign that informs the general public of a safety message or call to action through the use of tabling at community events, public service announcements, pamphlets, billboards, commercials, and art.

Example: Merced County has a [driver awareness safety campaign](#) where California Highway Patrol (CHP) uses a comprehensive statewide approach to promote and enforce safe pedestrian, bicyclist, and motorist behavior, ensuring all road users are sharing the road in a safe manner.

When to use: To educate residents on how to create safer streets for all and create an atmosphere where the community can look after one another's safety.

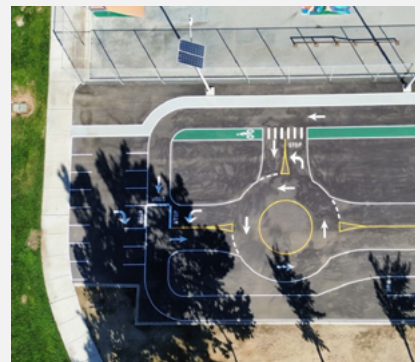


Traffic garden

A traffic garden is a scaled-down street network where children and new riders practice biking and road safety in a car-free space. The mini system contains elements people regularly find on real roads: vehicle lanes, bicycle lanes, stop signs, pedestrian crossings and a bus stop.

Example: The Transportation Agency of Monterey County opened a [traffic garden](#) at San Antonio Park in King City where residents can bring scooters and bicycles to test the route or participate in the safety training, or partake in bicycle and scooter repair workshops.

When to use: To provide a safe, fun environment for children and adults to learn about road safety and practice navigating streets and intersections, free from actual traffic.



Safe Routes to School programming

Designated safe route

A route identified as safer than other options for community members to walk and bike. These routes typically provide better walking and biking infrastructure to and from their destination.

Example: The City of [Hayward's Safe Routes for Seniors \(SR4S\) Program](#) is a collaborative effort between the City and local senior housing facilities, senior centers, and community-based organizations that work to identify areas in Hayward at which to focus accessibility and walkability improvements.

When to use: To provide safe routes, especially for vulnerable populations in a community, to walk and bike to local destinations, which may include community hubs like schools, libraries, and recreational centers.



Safe Haven program

A program that partners with local businesses and community organizations to serve as safe places where students can go and ask for help on their walk to and from school.

Example: The Valley Transportation Agency, a transit provider in Santa Clara County, is an active participant in the [Safe Haven Program](#) and ensures that any child in need of assistance can ask for or about “Safe Place” and the operator will ensure the child is safe and secure.

When to use: To improve the safety of students walking and biking in the community and provide opportunities for local businesses and community organizations to get involved directly in Safe Routes to School work.



Safe Passages program

A program that places parents and volunteers at key locations where students travel to get to and from school to support their safety and help them make it to school safely.

Example: The San Francisco [Tenderloin Community Benefit District Safe Passage Program](#) works to build a culture of safety, helping students feel and be safe through education, visibility, and engagement.

When to use: To improve the safety of people walking and biking in the community and provide opportunities for parents and volunteers to get involved directly in the Safe Routes to School work.



Safe Routes to School (SRTS) community program

A program that consists of a broad partnership of community stakeholders working together to promote walking and biking to school through education, incentives, and infrastructure improvements. The [Active Transportation Resource Center \(ATRC\)](#) created a resource library that includes a bicycle and pedestrian safety curriculum for students, a guide to start a walking bus or bicycle train, training for crossing guards and more.

Example: [Cupertino's Safe Routes to School \(SRTS\)](#) was created to promote a safer environment for Cupertino students and families to travel to and from school actively.

When to use: To create opportunities to promote walking and biking for school children, as well as create safer streets at and surrounding the campus.



School or community crossing guard program

A program that trains adults to direct the traffic of people walking, biking or driving at key intersections, typically near schools. These can be volunteer, part-time, or full-time positions. The Active Transportation Resource Center has provided a [guidebook](#) for the crossing guard program for administrators and employees.

Example: [Los Angeles City's Crossing Guard Program](#) deploys crossing guards to enhance the safety of students, especially those walking, biking, and rolling in school zones.

When to use: To improve the safety of people walking or biking to and from the school campus and provide new opportunities for local jobs.



Student Safety Patrol program

A program that enlists upper elementary, middle, and high school students to direct their peers to and from school during arrival and dismissal. Students can also be walking buddies and provide safe walking and biking education to younger classmates.

Example: The City of San Diego’s [Student Safety Patrol Program](#) promotes the safe crossing of elementary students to and from school and provides classroom education to improve student safety behavior.

When to use: To get school children involved in advocating for and creating safer routes to their schools.



Walking school bus

A group of students who walk to school accompanied by an adult along a designated route. Students, including those driven to school, join the walking school bus along several identified stops.

Example: The [Orange County Health Agency’s Walking School Bus](#) is an organized group of students that safely walks to school together with adult supervision. Similar to a carpool, the adult “bus driver” either meets the students at a designated meeting spot or picks them up along the walking route to school.

When to use: To encourage more youth to walk to school, improve the safety of people walking to school, and get students and their families involved directly in Safe Routes to School work.



About the Community Pedestrian and Bicycle Safety Program

The CPBSP is a statewide active transportation and community engagement project of [UC Berkeley Safe Transportation Research and Education Center](#) (SafeTREC) and [California Walks](#) (Cal Walks) that aims to reduce pedestrian and bicyclist fatalities and serious injuries in communities across California. The program engages residents, traffic safety stakeholders, and both traditional and non-traditional partners alike in active transportation planning and strengthens the capacity of community partners to create safer and more accessible streets for those walking and biking in their neighborhoods. It uses the Safe System Approach framework to engage residents and advocates to develop a community-driven action plan and context-sensitive recommendations informed by community feedback and participation in the program. Follow-up technical assistance is offered to communities that previously received training to support their pedestrian and bicycle safety efforts.

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Photo credits

Advocacy and policy

- Bicycle and/or pedestrian advisory committees: <https://www.campbellca.gov/175/Bicycle-Pedestrian-Advisory-Committee>
- Bicycle and/or pedestrian master plan: <https://www.srcity.org/2711/2018-Bicycle-and-Pedestrian-Master-Plan>
- Community benefit agreement: <https://www.ci.richmond.ca.us/4126/Community-Benefits-Policy-Development>
- Community coalition: <https://cocosouthla.org/sc-x-sc/youth-organizing/>
- Comprehensive safety action plan: <https://www.cityofhawthorne.org/home/showpublisheddocument/7635/638742608956000000>
- Engaged elected official: https://catsip.berkeley.edu/sites/default/files/styles/openberkeley_image_full/public/general/altadenagohumancampaign.jpg?itok=rmlBhZ_1×tamp=1649281804
- Funding opportunities that prioritize safety: <https://files.constantcontact.com/5f52d7af701/020c3be9-1557-4463-84d0-93fe8c38d055.pdf>
- Local Road Safety Plan (LRSP): https://www.cityofarcata.org/DocumentCenter/View/14368/Arcata_Local_Road_Safety_Plan-2024?bidId=
- Participatory campaign: <https://www.threads.net/@myrnamelgard7/post/DF8Yq4GyvaM>
- Vision Zero: <https://www.fremont.gov/home/showpublisheddocument/759/637750212463000000>

Data collection and analysis

- Evaluation: <https://escholarship.org/uc/item/2sn1j0cr>
- High-Injury Network (HIN): <https://www.oaklandca.gov/resources/high-injury-network-2024>
- Linking crash and medical data: https://skylab4.cdph.ca.gov/epicenter/_w_c23a14f8/image4a.png
- Pedestrian/bicycle count: <https://www.longbeach.gov/goactive/b/resources/eco-totem-counter/>
- Photo and VideoVoice: https://safetrec.berkeley.edu/sites/default/files/cpbst_fy23_castrovalley_follow-up_report.pdf
- Safe Routes to School (SRTS) data collection: <https://www.cityofpaloalto.org/Departments/Transportation/Safe-Routes-to-Schoo>

- Safe System Approach: https://www.transportation.gov/sites/dot.gov/files/images/Grants/Safe-System-Approach-Infographic_500px.png
- Street Story: <https://safetrec.berkeley.edu/tools/street-story-platform-community-engagement>
- Walking or biking assessment: <https://safetrec.berkeley.edu/programs/complete-streets-safety-assessments>
- Transportation Injury Mapping System (TIMS): https://tims.berkeley.edu/help/images/GISMapNew/1g_MapCon.png

Infrastructure

Bicycle infrastructure

- Bicycle box: <https://www.longbeach.gov/goactive/b/mobility-toolkit/bicycle-treatments/bicycle-boxes/>
- Bicycle lane: <https://www.modestogov.com/DocumentCenter/View/1722/Non-Motorized-Transportation-Plan-PDF?bidId=>
 - Protected bicycle lanes: https://www.calbicycle.org/the_california_bicycle_coalition_seeks_to_demystify_building_protected_bicycle_lanes_for_californian_cities/
 - Buffered bicycle lanes: <https://www.longbeach.gov/goactive/b/mobility-toolkit/bicycle-treatments/buffered-bicycle-lanes/>
 - Conventional bicycle lane: <https://www.modestogov.com/DocumentCenter/View/1722/Non-Motorized-Transportation-Plan-PDF?bidId=>
 - Bicycle boulevards: <https://berkeleyca.gov/city-services/getting-around/walking-and-biking/bicycle-boulevards>
- Bicycle parking: <https://uptownstationoakland.com/new-uptown-oakland-bicycle-station-now-open/>
- Bicycle sensor/detector: <https://www.danville.ca.gov/736/Traffic-Signal-Bicycle-Detection-Upgrade>
- Bicycle signal: <https://www.kimley-horn.com/project/north-fremont-street-bicycle-pedestrian/>
- Public bicycle repair station: <https://ladotlivablestreets.org/content-detail/Bicycle-Repair-Stations/>

Green infrastructure

- Median gardening: <https://www.cityoflapalma.org/198/Street-Medians>
- Permeable sidewalk/pavement: <https://sustainability.santabarbaraca.gov/sites/default/files/2024-03/2014-01-29%20037.jpg>
- Rain garden: <https://www.lovelafayette.org/city-hall/city-departments/engineering/city-construction-projects/first-street-rain-garden>
- Shade tree: <https://www.sacbee.com/entertainment/living/home-garden/article45623676.html>
- Sidewalk landscaping: https://static.wixstatic.com/media/e4f6ab_152ffc8c18f64e499d1d1363f50eba88~mv2.png/v1/fill/w_2500,h_3333,al_c/e4f6ab_152ffc8c18f64e499d1d1363f50eba88~mv2.png

Pedestrian infrastructure

- Curb ramp: <https://www.agsinc.com/projects/curb-ramp>
- Pedestrian head start (Leading pedestrian interval): <https://www.calbicycle.org/governor-signs-bill-that-gives-pedestrians-a-head-start/>
- Pedestrian lane: <https://ruraldesignguide.com/files/2016-12/20160714-9.jpg>
- Pedestrian zones:
 - Pedestrian plaza: <https://www.cityofgilroy.org/ImageRepository/Document?documentID=15669>
 - Pedestrian street (pedestrian mall): <https://www.cityofsanmateo.org/4448/B-Street-Pedestrian-Mall-Improvements>
- Pedestrian safety island (Pedestrian refuge island): <https://www.sfmta.com/projects/upper-market-street-safety-project>
- Pedestrian-scale lighting: <https://drive.google.com/drive/folders/136-eg0cMaBBiYEAOdcDH-987FP7r7JH->
- Pedestrian scramble: <https://www.santamonica.com/transportation/safety-information-getting-around-santa-monica/>
- Raised crosswalk: <https://www.sfmta.com/projects/wiggle-neighborhood-green-corridor>
- Sidewalk: <https://ruraldesignguide.com/files/photos/Los-Molinos-Sidewalk-Cropped.jpg>

Traffic safety infrastructure

- Complete Streets: https://catsip.berkeley.edu/sites/default/files/styles/openberkeley_image_full/public/general/complete-street.png?itok=nT6kL4Qu×tamp=1552430157
- Curb extension (Bulbout): <https://www.sfmta.com/getting-around/walk/pedestrian-improvements-toolkit/intersection-bulb-outs>
- Daylighting: <https://www.pinole.gov/sb-413-california-daylighting-law/>
- High-visibility road striping and signage: <https://www.cityofsanrafael.org/crosswalk-improvements/>

- Multi-use trail/Shared path: <https://parks.sonomacounty.ca.gov/visit/find-a-park/sonoma-valley-regional-trail>
- Neighborhood traffic circle (mini roundabout): <https://epasun.org/converting-two-east-palo-alto-temporary-traffic-circles-to-mini-roundabouts/>
- Paved shoulder: https://ruraldesignguide.com/files/photos/pg3-9_Photo_Alta.jpg
- Pedestrian hybrid beacon (High-intensity activated crosswalk [HAWK] beacon): <https://el-cerrito.org/1641/Pedestrian-Hybrid-Beacons>
- Protected intersection: <https://www.slocity.org/government/department-directory/public-works/programs-and-services/transportation-planning-and-engineering/madonna-road-protected-intersection-project>
- Quick-Build project: <https://www.sfmta.com/projects/folsom-street-quick-build-project>
- Rectangular rapid flashing beacon (RRFB): <https://www.fremont.gov/government/departments/public-works/public-works-projects/paseo-padre-parkway-improvements-project>
- Reduced speed limit zone: <https://www.cityofsanmateo.org/4715/Slow-for-Students>
- Road rightsizing (Road or traffic diet): https://siegfriedeng.com/wp-content/uploads/2022/09/California-St-Road-Diet-0.1-Striping-Conceptual-Rendering_2021-12-13_Page_1_Image_0003.png
- Roundabout: <https://www.burlingame.org/839/California-Drive-Roundabout-City-Project>
- Slow Streets: <https://cao-94612.s3.us-west-2.amazonaws.com/documents/23.02.01-SlowStreets-framework-presentation-rev1.pdf>
- Temporary demonstration project: <https://www.cityofepa.org/publicworks/page/temporary-traffic-circles>
- Vertical speed control elements: <https://nacto.org/publication/urban-street-design-guide/street-design-elements/vertical-speed-control-elements/>
 - Speed hump: <https://i0.wp.com/fresnoland.org/wp-content/uploads/2023/09/speedhump.jpg?fit=1024%2C473&ssl=1>
 - Speed table: <https://highways.dot.gov/sites/fhwa.dot.gov/files/images/Safety/tceprimer61.jpg>
 - Speed cushion: https://signalscv.s3.us-west-1.amazonaws.com/wp-content/uploads/2019/03/09225705/032719_Abelia_TM-1535x1024.jpg
- Wayfinding: <https://studiolimage.com/wf07-bbb.html>

Programming

Bicycle programming

- Bicycle rodeo: <https://solanosr2s.ca.gov/programs/biking-walking-programs/bicycle-rodeo/>
- Bicycle safety diversion program: <https://cal.streetsblog.org/2018/10/10/california-needs-more-bicycle-ticket-diversion-programs>
- Bicycle train: <https://sonomasaferroutes.org/content/bicycle-trains>
- Earn-A-Bicycle Program: https://www.tripsforkidsbayarea.org/uploads/1/2/9/0/129099217/20190802-134712_orig.jpg
- Helmet/light distribution: <https://taps.ucsc.edu/bicycle-programs/free-helmets.html>

Community safety programming

- Community liaison/Promotores campaign: https://www.losangeleswalks.org/our_promotoras
- Community walk or bicycle ride: <https://catsip.berkeley.edu/safety-story-adrian-cardenas>
- Neighborhood speed awareness program: <https://www.cityofnapa.org/DocumentCenter/View/13575/NTCP-Guidelines-and-Procedures-Document---Sep-2024-PDF>
- Open Streets: <https://www.morganhill.ca.gov/2381/Open-Streets-Morgan-Hill-Event>
- Parklet: <https://www.ci.richmond.ca.us/4618/Parklet-Program>
- Placemaking: <https://www.sandiego.gov/economic-development/business/starting/placemaking>
- Provide rapid response: <https://www.familiesforsafeststreets.org/about>
- Safety messaging campaign: <https://www.countyofmerced.com/3190/Campaigns>
- Traffic garden: https://www.montereycountynow.com/blogs/news_blog/tamc-will-open-a-traffic-garden-at-san-antonio-park-in-king-city/article_b96b082a-909b-11ee-9705-9bb8dc853cbb.html

Safe Routes to School programming

- Designated safe route: <https://www.hayward-ca.gov/SR4S>
- Safe Haven program: <https://www.vta.org/faq/will-bus-driver-help-my-child-and-offer-safe-place-if-they-are-trouble>
- Safe Passages program: <https://tlcbd.org/safe-passage/>
- Safe Routes to School (SRTS) community program: <https://www.cupertino.gov/Your-City/Departments/Public-Works/Transportation-Mobility/Safe-Routes-to-School-SR2S/About-SR2S>
- School or community crossing guard program: <https://ladot.lacity.gov/crossingguard>
- Student safety patrol program: https://goldenhill.sandiegounified.org/programs/safety_patrol
- Walking school bus: <https://www.ochealthinfo.com/services-programs/pregnancy-and-parenting/child-safety/injury-prevention-program/walk-school-day-6>

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For more information, please visit the CPBSP page at <https://safetrec.berkeley.edu>.



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