



TAHOE
REGIONAL
PLANNING
AGENCY

2024

VISION ZERO STRATEGY

TAHOE REGIONAL PLANNING AGENCY

Lake Tahoe



FINAL
February 2024

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1.0 INTRODUCTION & BACKGROUND

From 2013-2021 there have been approximately 41 fatalities and 183 serious injuries on roadways within the Lake Tahoe Region; an average of 5 fatalities and 20 life-changing serious injuries each year. These are not just numbers, but family members, friends, colleagues, and community members. The Lake Tahoe Region Vision Zero Strategy seeks to collectively reduce crashes on Tahoe roadways, particularly fatal and serious injury crashes. The Tahoe Regional Planning Agency (TRPA) acting as the metropolitan planning organization (MPO) is charged with improving roadway safety in our region through safety planning, regional stakeholder coordination, education, policy making, and setting and reporting on federally mandated safety performance targets. The Vision Zero Strategy was developed in collaboration with the Tahoe Region's transportation partner agencies and stakeholder organizations who all have a role in improving safety in the region. The process used to develop the Vision Zero Strategy brought these stakeholder agencies together to consider data analysis findings, recommendations, projects, and changes in how transportation projects are developed. This analysis will be used by TRPA and its partner agencies to inform transportation projects and policy decision-making that will improve safety for all road users.

1.1 What is Vision Zero?

Vision Zero is a strategy to eliminate all traffic fatalities and serious injuries, while increasing safe, healthy, and equitable mobility for all. First implemented in Sweden in the 1990s, Vision Zero has proved successful across Europe and is now gaining momentum in American cities, counties, and regions. The traditional approach to roadway safety tells the narrative that traffic deaths are inevitable "accidents," and that the responsibility is on individuals to drive safely. Vision Zero seeks to move beyond traditional transportation safety practices by shifting the narrative to say that although human mistakes are inevitable, traffic deaths are preventable. Through a systems approach, the road system and related policies can be designed to reduce the outcomes of mistakes and lessen the severity of crashes.¹



Figure 1.1: Vision Zero Approach vs Traditional Approach to traffic safety. Source: Vision Zero Network

¹ Vision Zero Network

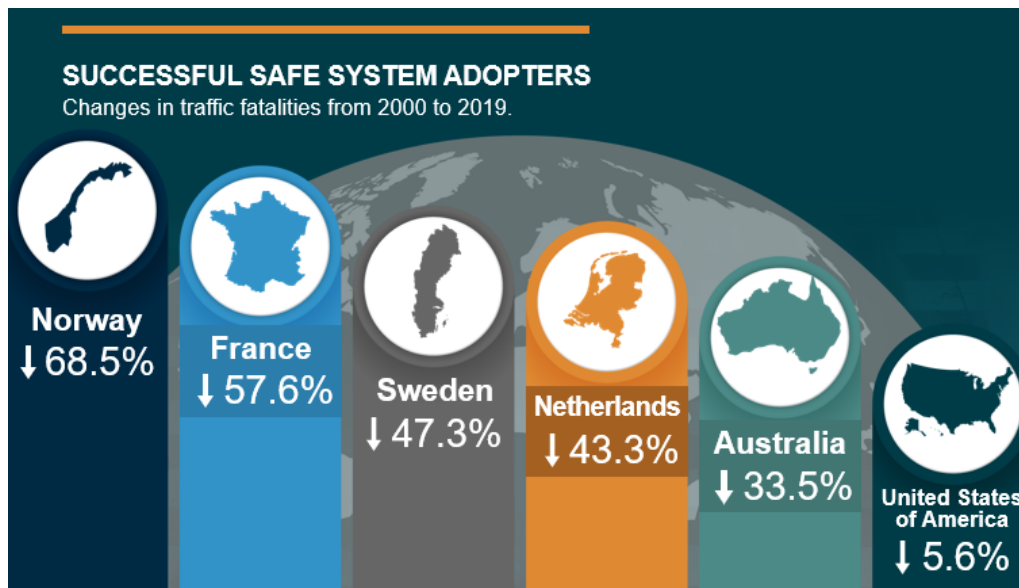


Figure 1.2: Successful Safe System Adopters; changes in traffic fatalities. Source: FHWA with data from World Health Organization Global Health Observatory Repository

With proven success around the world, more than 45 communities in the United States have committed to Vision Zero, and the Lake Tahoe Region is joining that movement and committing to move beyond traditional safety practices. Vision Zero is based on the Federal Highway Administration’s (FHWA) Safe System Approach, which is the guiding paradigm to address roadway safety². The Safe System approach is shaped by six principles, which serve as a roadmap to this plan:

1. Death and Serious Injuries are Unacceptable

The fundamental principle of Vision Zero is that human life and health are the top priorities in the transportation system. The National Highway Traffic Safety Administration and Center for Disease Control and Prevention have referred to traffic deaths as a national preventable health crisis³. Staff will be seeking a public commitment from the TRPA Governing Board to an eventual goal of zero roadway fatalities and serious injuries by 2050 on February 28, 2024. The draft resolution is shown in Appendix C.

2. Humans Make Mistakes

The transportation system can be designed and operated to accommodate certain types and levels of human mistakes and avoid death and serious injuries when a crash occurs. Vision Zero promotes

² FHWA

³ Center for Disease Control & Prevention

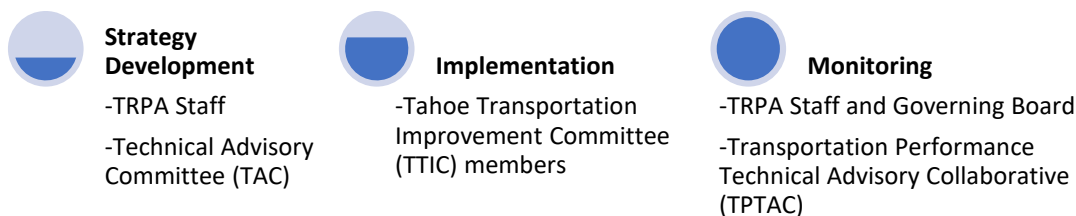
infrastructure designs that account for human vulnerabilities. For example, adding edge line rumble strips will alert the driver and can reduce roadway departure crashes. The Countermeasures Toolbox in Appendix A and the projects list in chapter 6.0 were developed to assist implementing agencies in planning safety projects that consider people will inevitably make mistakes while driving.

3. *Humans Are Vulnerable*

While all humans are vulnerable to crash forces, those without an outside shield, including pedestrians, bicyclists, persons in a wheelchair, scooter users or skateboarders, and road workers face a higher risk of injury in collisions. This plan prioritizes the safety and needs of vulnerable road users throughout, but especially in the data analyses in Chapter 2.0. The countermeasures toolbox includes recommendations to address bicycle and pedestrian crashes and considerations of bicycle and pedestrian volumes. By making the roadway safer for people walking, biking, and rolling, the road is safer for all.

4. *Responsibility is Shared*

While drivers, bicyclists, and pedestrians are still accountable for roadway decisions, Vision Zero emphasizes that safety on the road is not the *sole* responsibility of road users, rather a shared responsibility. This strategy was developed with input from a Technical Advisory Committee (TAC), further detailed in section 1.4. The TAC includes local and state government agencies, community advocacy groups, police and fire departments, and private sector representatives. Each stakeholder has a unique role in advancing safety in the region and accelerating progress towards zero. The graphic below shows the primary groups tasked with developing, implementing, and monitoring this strategy.



5. *Safety is Proactive*

While crash data is emphasized throughout the strategy, we recognize that it may not always tell the full story. By looking at roadway characteristics in a Bicycle Level of Traffic Stress (BLTS) Analysis, TRPA seeks to proactively identify potential locations where vulnerable road users experience a higher stress level.

6. Redundancy is Crucial

Improving safety requires that all parts of the transportation system are strengthened. Vision Zero looks to build redundancy in safety measures to mitigate the consequences of human errors and other factors that can lead to crashes. This strategy makes interdisciplinary recommendations to address safety from multiple approaches, including engineering through countermeasures and projects, education programs, and policy recommendations. Redundancy also means that transportation safety is identified and improved at all levels, across local, county, state, and federal governments. This strategy focuses on challenges and solutions that cross jurisdictions and major transportation corridors; however, several local jurisdictions have developed their own safety plans to address localized issues:

- [Placer County Local Roadway Safety Plan](#) - 2021
- [El Dorado Local Roadway Safety Plan](#) - 2022
- [Washoe County Tahoe Transportation Plan](#) - 2023
- City of South Lake Tahoe Vision Zero Action Plan – in progress, expected 2024

1.2 TRPA's Role in Safety

As the Tahoe Region's federally-designated metropolitan planning organization and the bi-state compact agency that California and Nevada created 50 years ago to manage growth, development, and land use in the Tahoe watershed, TRPA has several roles when it comes to safety.

Planning & Coordination

One of TRPA's main roles as the metropolitan planning organization and Regional Transportation Planning Agency (RTPA) is developing short-term and long-term regional transportation plans with coordination from local and state jurisdictions. Vision Zero aligns with TRPA's plans, including the Active Transportation Plan, Complete Streets Resource Guide, and [2020 Linking Tahoe: Regional Transportation Plan \(RTP\)](#). In 2024, we will be updating our Intelligent Transportation Systems (ITS) Strategic Plan with Vision Zero in consideration, which will identify opportunities for technology to improve transportation efficiency, safety, and balance. The Vision Zero strategy also aligns with TRPA's strategic initiative Keeping Tahoe Moving, which aims to provide transformative changes to Tahoe's transportation system, including complete streets, pedestrian-friendly town centers, and improved safety. On October 2nd and 3rd 2023, TRPA staff attended a two-day Local Roadway Safety Audit to discuss appropriate speeds and design on Caltrans right of way within the



City of South Lake Tahoe’s jurisdiction where the highway functions as a local main street for the corridor.

TRPA coordinates with local, state, and federal transportation agencies in the planning, design, and implementation of projects. TRPA participates in the Tahoe Transportation Implementation Collaborative (TTIC). The TTIC coordinates the efficient implementation of key transportation investments and programs that support local and regional transportation goals. TTIC participates in the prioritization and sequencing of transportation projects for the Regional Transportation Plan, regional funding programs (Regional Grant Program), and other discretionary grant requests. The TTIC is not a formal committee, but rather a partner driven collaborative for TRPA and partners to provide technical input to policy boards and work through transportation challenges and share resources.

Local Jurisdictions	Utility/Special Districts	Transit Agencies/Orgs.	State/Federal/Other
Placer County	IVGID	NTCD	Caltrans
El Dorado County	NDOT	TTD	NDOT
Washoe County	TRCD	TMA's	CA & NV State Parks (as needed)
Douglas County	NTPUD	TART	USFS
CSLT	TCPUD		TRPA

Figure 1.3: TTIC partner agencies

Programs

TRPA co-hosts the **Tahoe Bike Month** every June alongside the Lake Tahoe Bicycle Coalition. Bike Month seeks to encourage people to ride their bike instead of driving by offering prizes for logging miles. There are community events all month, including free bicycle repair workshops called “Bike Kitchens,” bike path clean-ups, Bike to Work Days, and Bike/Walk to School Days. TRPA also leads two school programs that complement Bike Month: a Safe Routes to School (SRTS) Program and Bicycle Rodeo events. Every May, just prior to Bike Month, TRPA staff visit fourth grade classes to teach children bicycle safety including the rules of the road, a basic bike check, and how to make sure their helmet fits properly. This empowers students to feel safe riding their bike and encourages them to ride to school the following month for Bike Month. In June, staff hosted Bicycle Rodeos at the South Tahoe Middle School for sixth grader students. The rodeos go a step further than the SRTS program with a hands-on approach; teaching bicycle skills, like how to pump up a tire, rules of the road, and bike handling skills.



In summer of 2022, **Take Care Tahoe** launched the “Take it Slow, Tahoe” campaign aimed to capture the attention of drivers and remind them to drive slower to protect people and animals. This campaign was proposed by an Incline Village resident who was hit by a driver while legally crossing the street in a crosswalk. TRPA, a Take Care partner, helped launch this campaign and distribute free lawn signs to the community. Approximately 1000 lawn signs were distributed.



Funding

TRPA allocates funding to the local jurisdictions for transportation projects that achieve regional transportation planning goals through the biennial competitive Regional Grant Program. Given safety is one of those regional goals, the Regional Grant Program performance assessment uses crash data as a criterion for project scoring. TRPA also supports local eligibility for competitive funding opportunities.

Permitting

TRPA is not only the MPO, but also a regional environmental planning agency, which means transportation projects subject to TRPA environmental permitting undergo evaluation by TRPA’s Permitting and Compliance Department.

Data & Monitoring

As the MPO, TRPA is required annually to establish regional targets to reduce fatalities and serious injuries in coordination with each state that must support federal performance measures. Both California and Nevada have statewide initiatives with goals of zero fatalities by 2050. Developing this strategy in coordination with the local jurisdictions will help TRPA support federal Performance Measurement 1 (PM 1), Safety goal. TRPA also maintains regional databases, with publicly accessible transportation data on [Lake Tahoe Info](#) and [Tahoe Open Data](#). The goal is to connect people with information to improve decision making and sustain investments in the Lake Tahoe Basin. This data is often utilized by local partners when applying for state and federal discretionary grants.

TRPA has developed an adaptive management approach to improve transportation resource management across the Tahoe Basin. This approach links information collected through monitoring and evaluation with the planning process to dynamically adjust the strategies that guide the region towards goals established by the Regional Transportation Plan and other local, state, and federal requirements. The monitoring process includes regular reporting on transportation metrics every two years. An advisory body of TRPA staff and stakeholders, called the Transportation Performance Technical Advisory Committee, is responsible for the regular reporting and recommendations. Committee members include representatives from Placer County, Douglas County, Washoe County, El Dorado County, Carson City, City of South Lake Tahoe, TTD, TNT-TMA, SSTMA, NDOT, Caltrans, League to Save Lake Tahoe, USFS, and from the general public. As safety falls under several explanatory metrics tracked, this group will be essential for monitoring progress towards Vision Zero.

1.3 Safety Policies

The Regional Transportation Plan (RTP) establishes goals and policies for the region with a 25-year planning horizon. Providing a safe transportation system has been a part of the goals of the Regional Transportation Plan since 2004 and remains in the current RTP with several explicit policies aimed at improving safety on roadways. TRPA staff reviewed these policies through the lens of Vision Zero and identified revisions to strengthen safety. The proposed policy revisions will be considered in the upcoming RTP update, which begins in 2024.

Policy 3.1:

Coordinate the collection and analysis of safety data, identify areas of concern, and propose safety-related improvements and user awareness that support state and federal safety programs and performance measures.

No changes proposed.

Policy 3.2:

Use proven safety design countermeasures for safety hotspots when designing new or modifying existing travel corridors consistent with the Lake Tahoe Region Safety Strategy.

Revise Policy 3.2: Consider safety data and use proven safety design countermeasures for safety hotspots recommended from roadway safety audits, the active transportation plan, corridor plans, and other reliable sources when designing new or modifying existing travel corridors.

Policy 3.3:

Coordinate safety awareness programs.

Revise Policy 3.3: Coordinate safety awareness programs with local agencies that encourage law abiding behavior by all road users.

Policy 3.4: Support emergency preparedness and response planning, including the development of regional evacuation plans, and consider climate resiliency measures.

Revise Policy 3.4: Replace policy with Policy ENV-3.0 below from Transportation Equity Study.

Policy 3.5:

Encourage appropriate agencies to use traffic incident management performance measures.

No changes proposed

Policy 3.6:

Design projects to maximize visibility at vehicular, bicycle, and pedestrian conflict points. Consider increased safety signage, site distance, and other design features, as appropriate.

Revise Policy 3.6: Design projects to maximize visibility of pedestrians and bicycles, incorporating daylighting, with a focus on vehicular, bicycle, and pedestrian conflict points. Consider increased safety signage, site distance, and other design features from the Lake Tahoe Countermeasures Toolbox.

Policy 4.6:

Identify opportunities to implement comprehensive transportation solutions that include technology, safety, and other supporting elements when developing infrastructure projects.

No changes proposed

Policy 6.1:

Preserve the condition of sidewalks and bicycle facilities and maintain, where feasible, for year-round use.

No changes proposed

Policy 6.3:

Maintain and preserve pavement condition to a level that supports the safety of the traveling public and protects water quality.

No changes proposed

Transportation Equity Study Policies

TRPA recently developed a set of equity-based policies that were included in the 2023 [Transportation Equity Study](#) and endorsed by the TRPA Governing Board. The following equity policies have connections to safety and are carried forward for recommendation in this Vision Zero strategy:

Policy A-1.0: *Ensure that Community Priority Zones have adequate or comparable snow removal and other services to ensure year-round access to employment, recreation, and goods and services*

Policy I-1.0: *Utilize the Equity Index Scorecard to establish equity-based performance measures for agency operations, programming, and planning.*

Policy I-1.1: Ensure all proposed transportation projects, programs, and policies meet transportation needs and minimize negative impacts for all communities, particularly disadvantaged communities, and people with special needs.

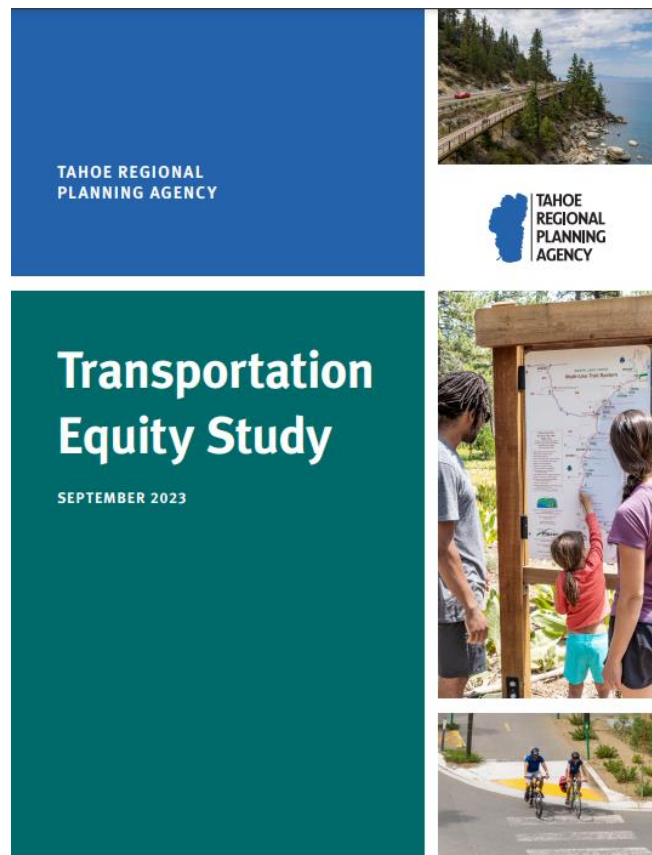
Policy I-1.2: Ensure all services and modes of transportation are equitable and accessible, specifically for communities and neighborhoods identified as Community Priority Zones in the RTP.

Policy S-3.0: Ensure services to public and active transportation are compatible and accessible to Tribes and communities, specifically for people with disabilities, households with little to no internet, low-income households, households with zero vehicles, etc.

Policy ENV-1.0: Consider utilizing smart (motion sensor) street lighting to reduce light pollution (dark sky) and reduce energy while providing safety for peds and other users.

Policy ENV-3.0: Provide an opportunity for local jurisdictions to begin discussions around coordinated evacuation planning with transportation departments and transit agencies.

Policy T-3.0: Support coordination among state and local agencies to implement a multijurisdictional Transportation Management Center.



1.4 Plan Development

The Lake Tahoe Region Vision Zero Strategy is not a new plan, but a comprehensive update to the 2019 Lake Tahoe Region Safety Strategy with a focus on the principles and goals of Vision Zero. The Vision Zero Strategy goes further than the previous plan with a Governing Board commitment to Vision Zero, a focus on equity, assessment of current policies, and a clear description of how progress will be measured over time. While the strategy is data-driven with an extensive analysis of crash locations, data does not always tell the full story. There may be areas that people avoid traveling to because they feel unsafe or have experienced a near-miss collision. This update seeks to supplement crash data with roadway characteristic stress analyses, public outreach, and stakeholder input.

The strategy was developed in-house in coordination with the Tahoe Region's transportation partner agencies and stakeholder organizations. TRPA convened a transportation Technical Advisory Committee (TAC), inviting representatives from over 20 regional partner agencies to participate and provide feedback and recommendations. The stakeholder agencies considered data analysis findings, strategies, and projects with an overarching goal of collectively reducing crashes on Tahoe roadways. TRPA seeks to support local jurisdictions in identifying and implementing projects that reduce crash frequency and severity.

Technical Advisory Committee:

- **California Department of Transportation** (Caltrans)
- **Nevada Department of Transportation** (NDOT)
- **City of South Lake Tahoe** (Public Works & Development Services Departments)
- **El Dorado County** (Tahoe Engineering Division)
- **Placer County** (Tahoe Engineering Division)
- **Douglas County** (Public Works Department)
- **Washoe County** (Public Works Department)
- **Tahoe City Public Utility District** (TCPUD)
- **Tahoe Transportation District** (TTD)
- **South Shore Transportation Management Association** (SSTMA)
- **Lake Tahoe Bicycle Coalition**
- **The League to Save Lake Tahoe**
- **City of South Lake Tahoe Police Department**
- **City of South Lake Tahoe Fire Department**
- **Douglas County Sheriff**
- **Tahoe Douglas Fire Protection District**
- **El Dorado County Sheriff**

- **Washoe County Sheriff**
- **Lake Valley Fire Department**
- **Achieve Tahoe**
- **Placer County Transportation Planning Agency (PCPTA)**
- **California Tahoe Conservancy**

The TAC was convened three times, in February, April, and August 2023. At the February kick-off meeting, the group provided input on the scope and goals of the strategy. Stakeholders requested that TRPA consider supplemental inputs, such as land use and roadway characteristics, in addition to crash data. The second meeting was focused on data and technical analyses. TRPA staff shared the crash data dashboard, proposed a High Injury Network methodology, discussed the countermeasures toolbox, and introduced two traffic stress analyses. Staff also discussed the public outreach plan with the group and shared the transportation safety survey. Committee members provided feedback on the High Injury Network inputs and the countermeasures toolbox. The final meeting in August discussed recent crashes and after-action processes, highlighted changes to the countermeasures toolbox, and shared the draft High Injury Network and draft Bicycle Level of Traffic Stress. TRPA also proposed a project selection and prioritization criteria at this final meeting, which was well received with positive feedback.

In addition to the three TAC meetings, TRPA met one on one with representatives from each of the law enforcement agencies with jurisdiction in the Tahoe Basin. This includes the California Highway Patrol, Nevada Highway Patrol, City of South Lake Tahoe Police Department, El Dorado County Sheriff, and Douglas County Sheriff. Law enforcement agencies play a significant role in Vision Zero, as enforcement agencies, as first responders at the scene of crashes, and as crash data reporters. When a crash occurs, the responding law enforcement agency reports crash data to their respective statewide crash data system, SWITRS for California and NDOT for Nevada. These systems compile crash data from across the state, filter out duplicates, clean up coordinates, and standardize fields. This process means that final statewide crash data is not typically available for 18 months to 3 years post-crash.

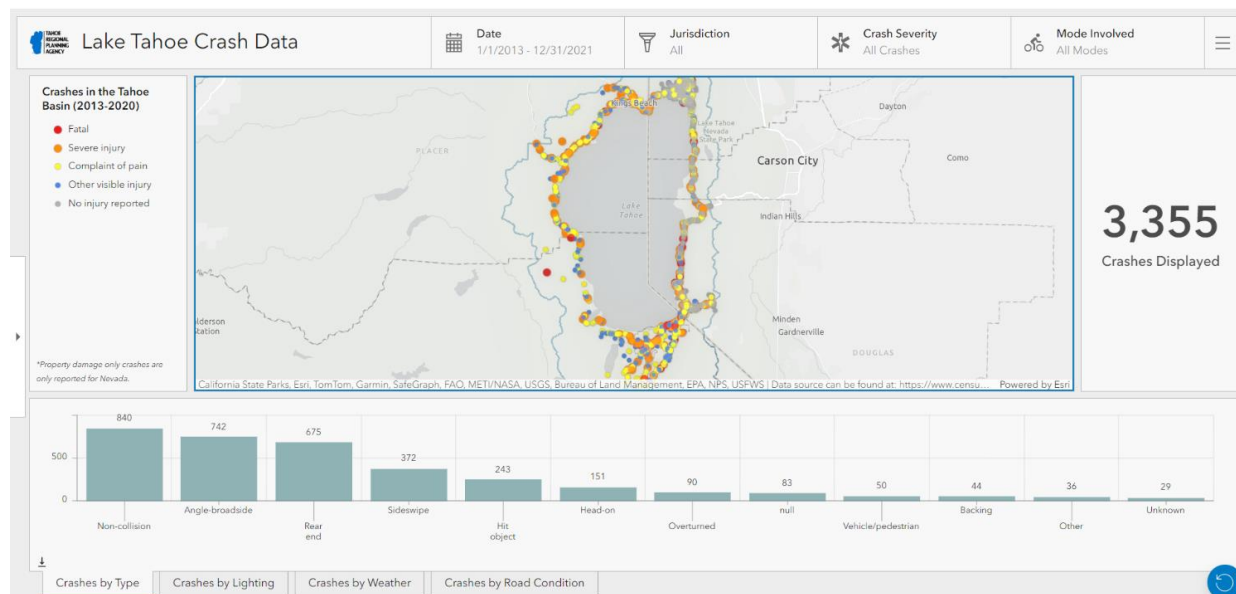
Meetings with law enforcement centered around crash data reporting, after-action processes, and crash hot spots. Meetings with law enforcement helped TRPA understand the nuances of crash data reporting in Tahoe, which varies by jurisdiction, and identify potential opportunities to receive crash data faster. Feedback from law enforcement informed the strategies section and project list identification.

2.0 CRASH DATA ANALYSIS

To identify systemic factors and trends behind crashes and identify strategies to improve roadway safety, TRPA evaluated the most recent nine years of complete crash data (2013 – 2021) available from the California and Nevada portion of the TRPA boundary area. When a crash occurs on a road in the Tahoe Basin, either the state (Nevada Highway Patrol or California Highway Patrol), county, or city law enforcement respond and generate a crash report. These crash reports are then submitted to a statewide reporting system which compiles, cleans, and processes crashes for the entire state. California data was obtained from the [California Statewide Integrated Traffic Records System \(SWITRS\)](#). Nevada crash data was provided directly from [Nevada Department of Transportation \(NDOT\)](#) to TRPA. The two state databases maintain different crash attributes and report similar attributes differently, making comparison for analysis challenging. As property damage only crashes are not reported in California, they were excluded from the dataset and so that the crash analysis focuses on locations where crashes resulted in injuries. Staff cleaned up and coded data from each state to analyze all the crash data together.

From 2013 to 2021 there were approximately 1,673 reported crashes in the Tahoe Basin involving an injury and 224 of those resulting in a serious injury or fatality. These crashes have been analyzed to consider crash severity, mode involved, crash type, lighting conditions, weather, primary collision factor/violation, and time of year. Unless otherwise noted, the following analyses in this chapter are based on 2013 to 2021 data, sourced from SWITRS and NDOT.

TRPA developed the [Lake Tahoe Crash Data Dashboard](#) as a tool for stakeholders and the public to view crash data trends easily and transparently. Users can select filters at the top to view crashes during a specific date range, by jurisdiction, by crash severity, or by mode involved. The bottom graphs show crashes by type, lighting, and weather. Filters can also be combined for a greater level of detail. For example, users can view the locations and crash details of all pedestrian-involved crashes that occurred in the dark. This enables transportation planners and engineers to analyze crashes at any scale – from the regional level down to the local level or to the street level. The dashboard will be regularly updated and will serve as an essential tool to track the Tahoe Region’s progress towards our Vision Zero goal and display outcome data.



2.1 Analysis of Crash Data

Crashes by Year

From 2013 to 2021, there have been an average of 5 fatalities and 20 serious injuries each year. While there is a slight decrease in fatal and serious crashes in 2020 and 2021, it is too soon to conclude if this is a trend or an anomaly. The COVID-19 pandemic stay-at-home orders and travel restrictions significantly reduced traffic volumes in 2020 and 2021. Research from the AAA Foundation for Traffic Safety's New American Driving Survey (2020)⁴ showed the average number of all daily personal car trips decreased by 45 percent in April 2020 and decreased by 40 percent for trips by all modes of transportation combined in the United States. As travel patterns normalized in 2022 and 2023, crash data from these years will help clarify if this is a trend or anomaly. Currently, 2022 crash data is preliminary from California and unreleased for Nevada. Staff expects final 2022 crash data to be released from both states in mid to late 2024, which will be updated on the Crash Data Dashboard.

Annual Total Roadway **Fatal** and **Serious** Injuries in the Tahoe Region

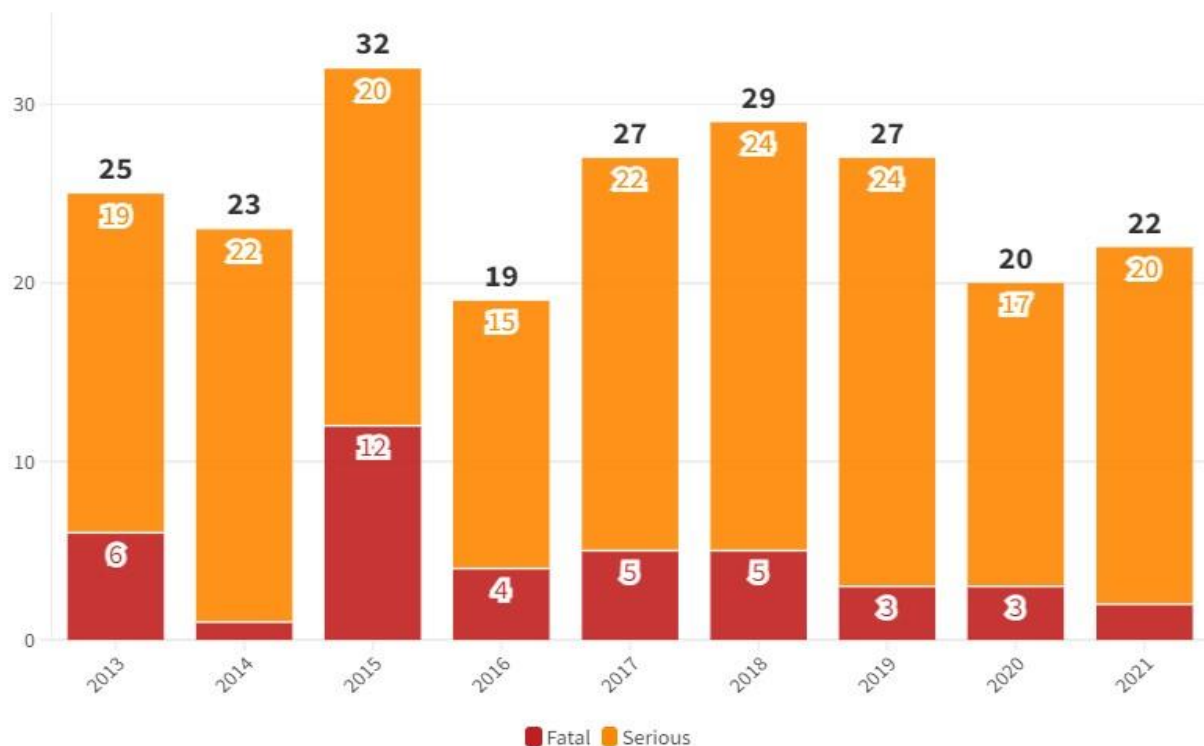


Figure 2.1: Fatal and Severe Crashes by Year (2013-2021)

⁴ Gross

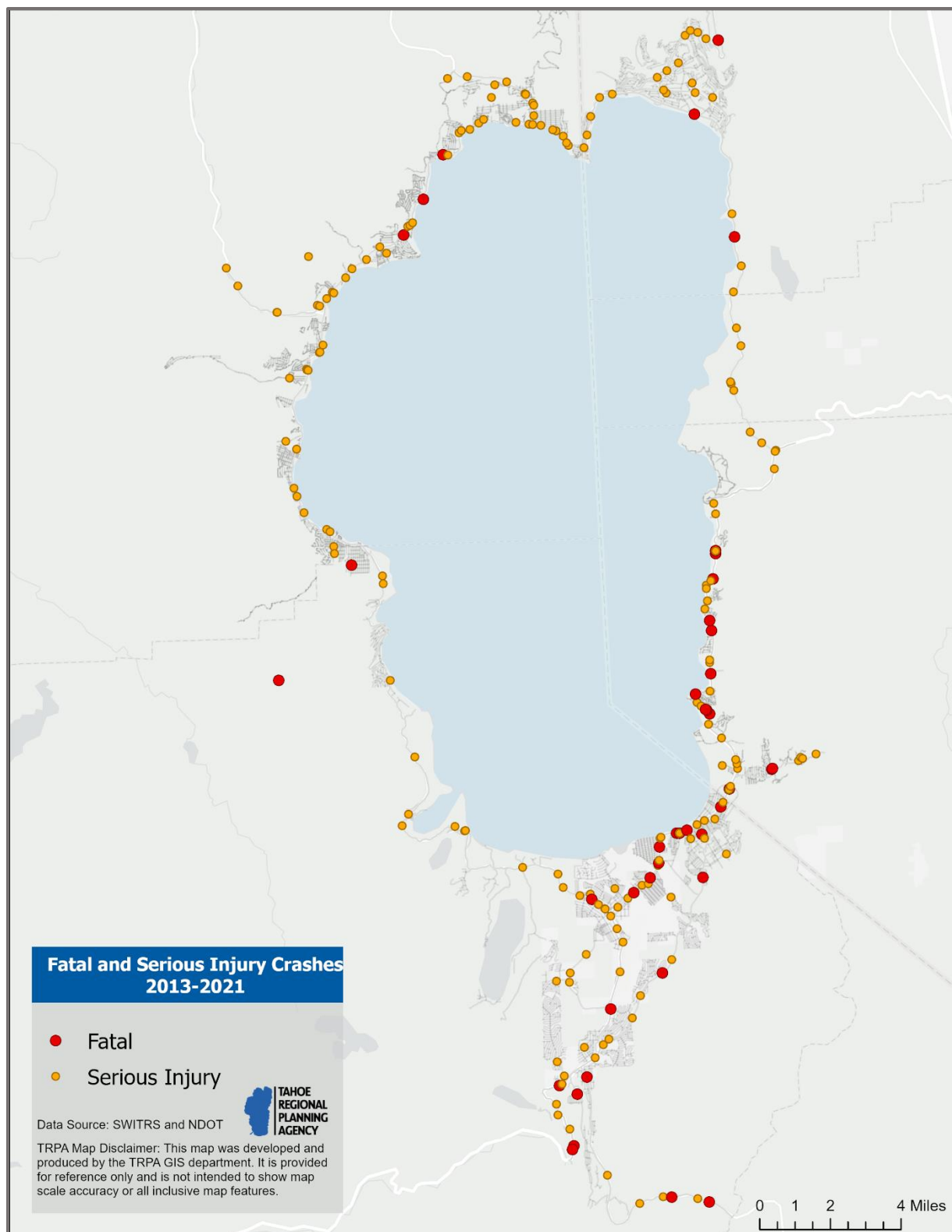


Figure 2.2: Locations of fatal and serious injury crashes

Comparison to State, Federal, and other Regions

Comparing the crash data in context with the state and federal level helps put Lake Tahoe's crash data numbers into context. Traffic fatality rates are displayed per 100,000 people to normalize the data. In 2020, California experienced 9.77, Nevada 10.1, the United States 11.78, and the Tahoe Basin 5.37 fatalities per 100,000.⁵ While Tahoe's numbers are low compared to the states and federal level, there is still work to be done to achieve zero. The city of Boulder, Colorado and city of Bend, Oregon experience fatality rates of 2.8 and 3.0, respectively. The city of Hoboken, New Jersey, with a population of approximately 59,000 people has reached Vision Zero, with seven consecutive years without a traffic death as of January 2024.

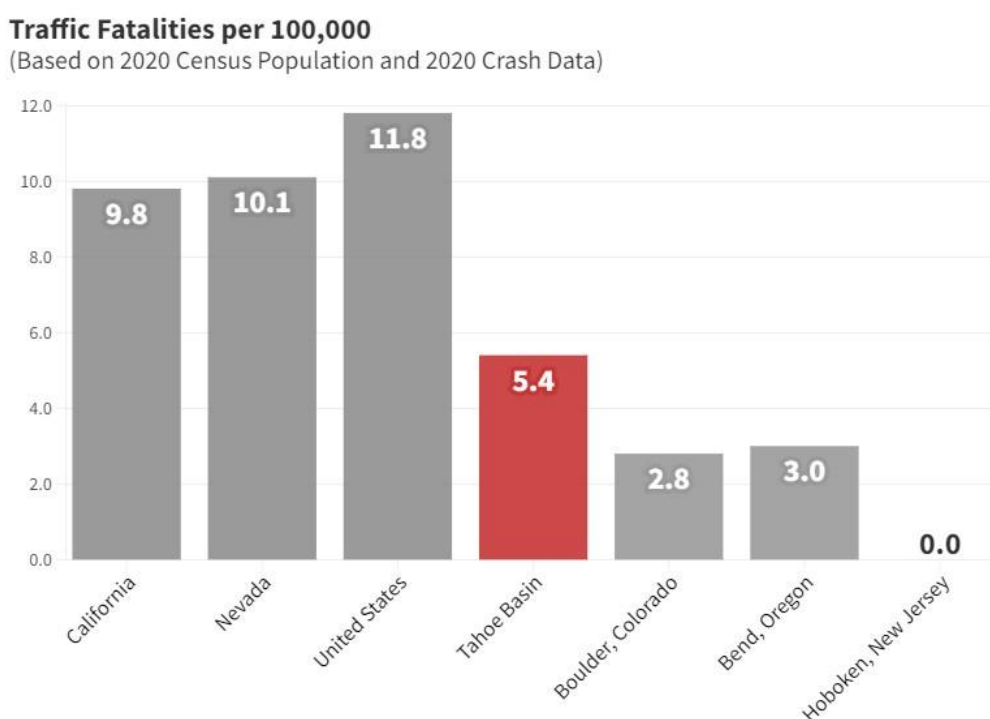


Figure 2.3: Traffic Fatalities per 100,000. Data sources: National Highway Traffic Safety Administration, United States Census Bureau, City of Boulder, Oregon Department of Transportation

Transit

Notably, public transit is missing from the below crash by mode breakdown. Statewide crash data does not specifically call out public transit vehicles as a party type in crash reports, so we are unable to compare injury crashes involving transit vehicles against the other modes. However, transit safety events are reported in Public Transit Safety Plans (PTSP) developed by each transit operator. It is important to note that the PTSP includes all incidents, such as falls at transit stops or on the vehicle. There have been no recorded deaths involving public transit vehicles in the Tahoe Region over the last

⁵ National Highway Traffic Safety Administration

five years (2017-2021). According to the American Public Transportation Association, traveling by public transportation is 10 times safer per mile than traveling by automobile and people can therefore reduce their chances of being in a crash by more than 90 percent if they take public transit instead of driving.⁶

Crashes by Travel Mode

Road users not surrounded by a protective structure, including pedestrians, bicyclists (or e-bicyclists), skateboarders, scooter users, or highway workers in work zones, sustain a greater risk of injury in any collision with a vehicle. These road users are classified as Vulnerable Road Users (VRU) by the Federal Highway Administration. While pedestrians and bicyclists make up 14 percent of all injury crashes, these road users are involved in 28 percent of all fatal and serious crashes and a further 31 percent of all fatal crashes. The higher percentage of vulnerable road users involved in fatal and serious crashes shows that the transportation system needs to be designed to prioritize safety of these users.

Travel Modes Involved in Injury Crashes:



148 Bicycles
Involved



95 Pedestrians
Involved



131 Motorcycles
Involved



1,302 Vehicle Only
Crashes

Percent of Crashes by Mode and Severity

■ Vehicle only ■ Motorcycle ■ Pedestrian ■ Bicycle

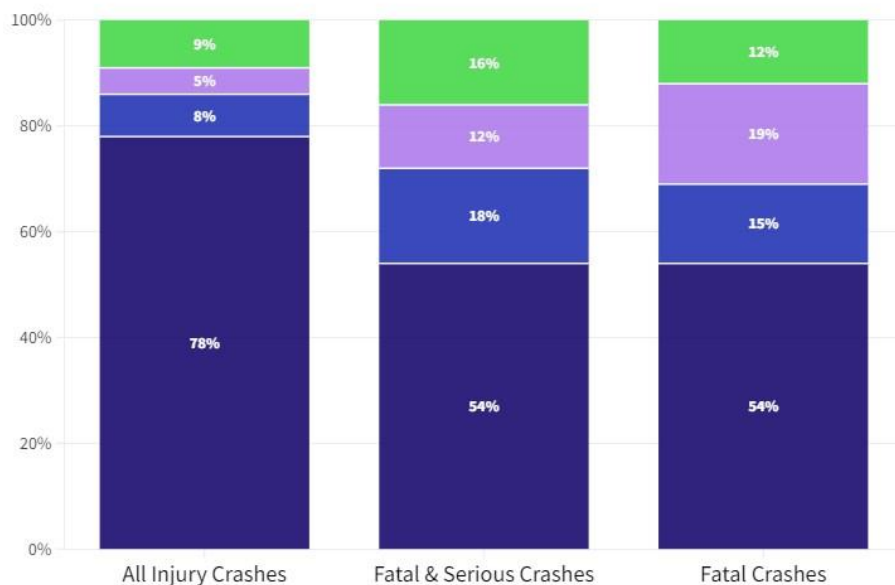


Figure 2.4: Crashes by Mode and Severity

⁶ American Public Transportation Association

Crashes by Month

Looking at the last nine years of crash data by month, we can see trends by month and by season. Notably, vehicle only crashes peak in the Summer months and Winter months and drop off in Spring and Fall. Bicycle and pedestrian-involved crashes also peak in the Summer, with a smaller winter peak. While June, July, and August are the highest months for pedestrian and bicycle crashes, pedestrian crashes are more dispersed throughout the year. These patterns indicate a combination of activity patterns associated with these modes and risk. Bicycling exhibits strong seasonality at Tahoe, whereas people tend to walk year-round given Tahoe's strong winter economy. At the same time, increased darkness in the winter months is associated with increased pedestrian crashes as shown in Figure 2.6 below.

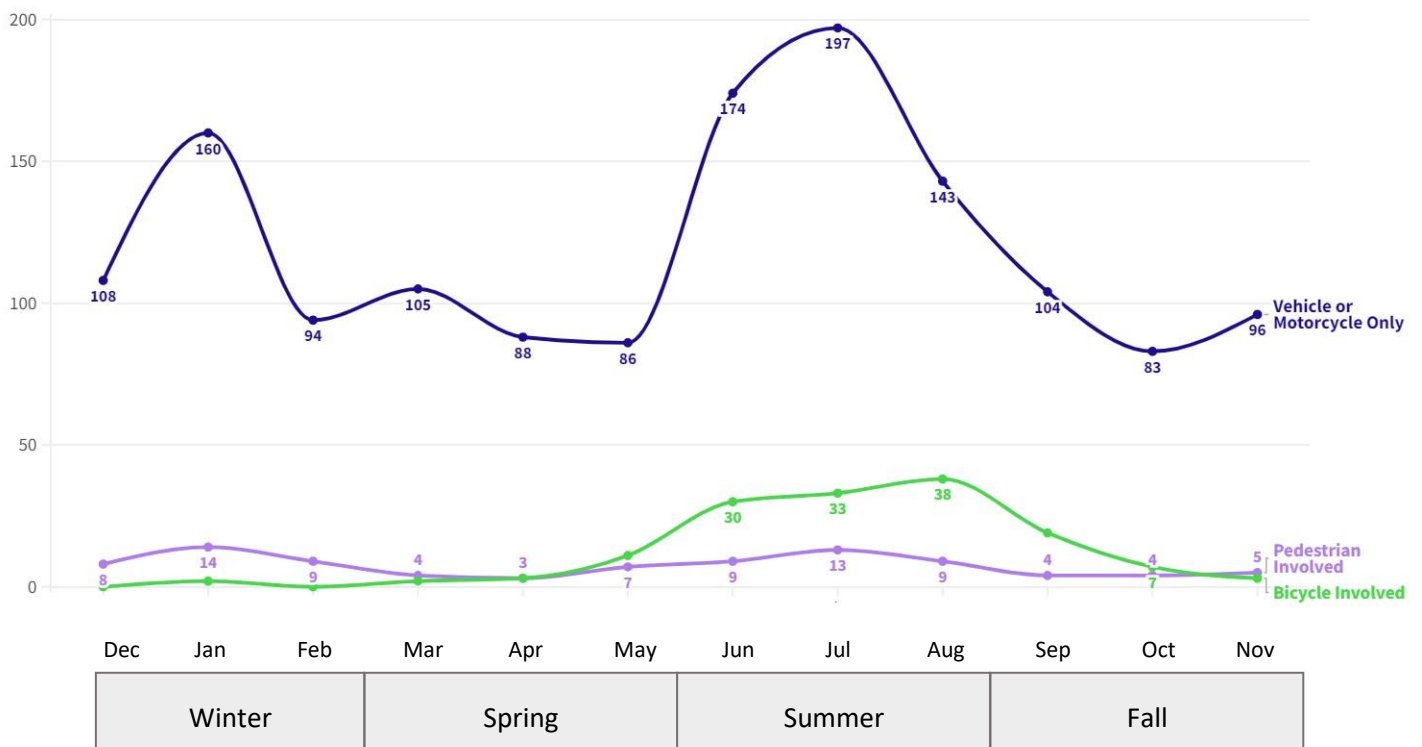


Figure 2.5: Injury Crashes by Month and Season

When looking at fatal and serious crashes only for all modes involved, the same Winter and Summer peaks are seen.



Figure 2.6: Fatal & Severe Crashes by Month and Season

Crashes by Weather

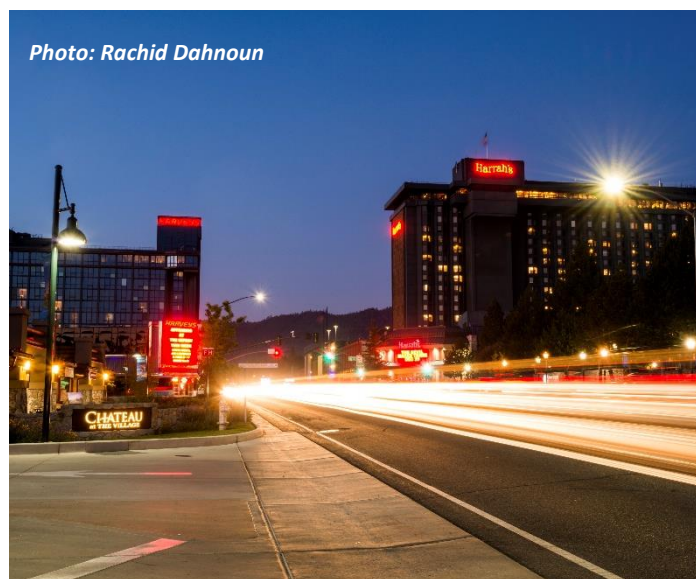
Weather does not seem to play a major factor in the occurrence of crashes at Tahoe, with 73 percent of all injury crashes and 81 percent of fatal and serious crashes occurring in clear weather. Approximately 70 percent of motor vehicle only crashes, 77 percent of pedestrian involved crashes, and 92 percent of bicycle involved crashes occurred when the weather was clear. In adverse rain or snow conditions, non-collision and angle-broad were the most common crash types for all injury levels.



Crashes by Lighting

Lighting influences pedestrian safety in the Tahoe Region. In total, 22 percent of vehicle and motorcycle crashes, 9 percent of crashes involving bicycles, and 48 percent of crashes involving pedestrians occurred in the dark. Out of these, 50 percent were in places without streetlights. Furthermore, 70 percent of fatal or serious pedestrian crashes happened at night. These statistics are significant when considering that fewer people are walking or driving at night, so there are fewer opportunities for crashes to occur than during the day.

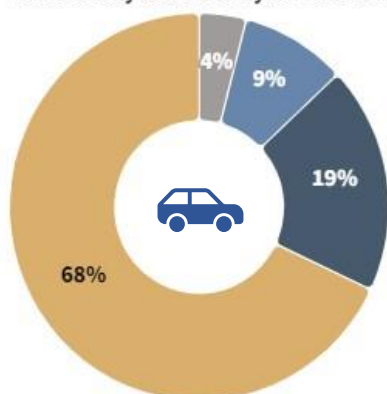
Potential contributing factors to reported night crashes could be related to drivers not seeing pedestrians early enough to slow down in time to avoid a crash, particularly on higher-speed roadways. Adding pedestrian lighting, such as spot-lighting in crosswalks, combined with other visibility-improving countermeasures, like curb extensions and flashing beacons, could help reduce this crash risk. All lighting would need to meet TRPA required night sky guidelines. Pairing reduced speeds with traffic calming would also improve pedestrian and driver safety.



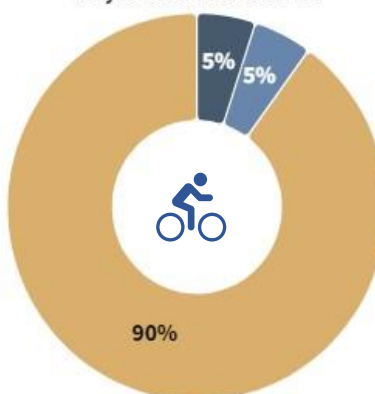
Fatal and Serious Injury Crashes by Mode and Lighting

Daylight Dark - no street lights Dark - street lights Other

Vehicle Only and Motorcycle Involved



Bicycle Involved Crashes



Pedestrian Involved Crashes

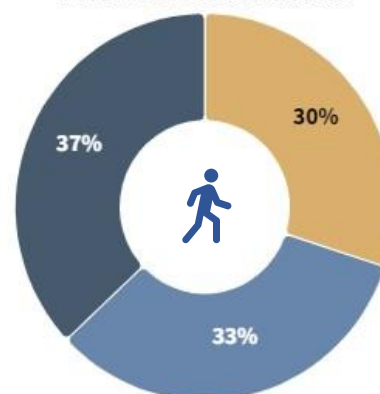


Figure 2.7: Crashes by Lighting

2.3 Analysis of Contributing Factors

Crash Types

Top Crash Types for All Injury Crashes:



Angle



Rear-End



Hit Object (CA)



Non-collision (NV)

Angle, rear-end, hit object, and non-collision crashes together make up 73 percent of all reported injury crashes occurring in Tahoe.

Top Crash Types for All **Fatal** & **Serious Injury** Crashes:



Angle



Head-On



Hit Object (CA)



Non-collision (NV)

Angle, head-on, hit-object, and non-collision crashes together account for 67 percent of all fatal and serious injury crashes occurring in Tahoe.

Angle Crashes: Also known as angle-broadside or “T-bone” crashes, an angle crash occurs when the front of one vehicle collides with the side of another. Most angle crashes involve a party failing to yield right of way, such as turning left across traffic or failing to stop at a stop sign or red light. Angle crashes make up 24 percent of all reported injury crashes and 22 percent of all fatal and serious injury crashes. Angle crashes do not necessarily involve two vehicles, but may involve an active road user; 40 percent of all injury crashes involving bicycles are angle crashes.

Rear-End Crashes: A rear-end crash involves one road user running into the back of another road user traveling the same direction. Rear-end crashes are typically caused by unsafe speeds, following too closely, and/or distracted driving. Rear-end crashes make up 24 percent of all reported injury crashes and 6 percent of all fatal and serious crashes.

Hit Object: This crash type is only used by the California crash reporting system. A hit object crash happens when a road user strikes a fixed object such as a tree, utility pole, or guardrail. While the majority of hit object crashes involve a vehicle only, there are a few instances involving active transportation modes. Hit object crashes make up 26 percent of reported injury crashes and 25 percent of fatal and serious crashes on the California side.

Non-collision: This crash type is only used by the Nevada crash reporting system. Non-collision indicates a single-vehicle crash, or a non-motorist involved, including single vehicle overturned, vehicle fire,

objects falling from or into the vehicle, and more. Non-collision crashes make up 33 percent of all reported injury crashes and rise to 45 percent of fatal and serious crashes on the Nevada side.

Head-on: A head-on crash occurs when the front side of two road users heading in opposite directions collide. Common contributing factors to head-on crashes are unsafe speeds, impaired road users, and distracted driving. Head-on crashes make up 7 percent of all reported injury crashes and 13 percent of fatal and serious crashes.

The Lake Tahoe Countermeasures Toolbox (Appendix A) includes tools to address these most common crash types. For example, removing, relocating, or protecting fixed objects adjacent to roads is recommended to mitigate risk and crash severity of **hit object** and **non-collision** crashes. Advance dilemma zone detection, signal timing adjustments, adaptive signal timing, and directional median openings are recommended countermeasures for **rear-end** crashes. Center line rumble strips, curve warning signs on horizontal curves, and chevron signs on horizontal curves are a few countermeasures that can address **head-on** crashes.

Primary Crash Factors

To determine the primary crash factors in the Tahoe Region and identify appropriate strategies and countermeasures, TRPA analyzed crash data for reported violations, driver factors, and vehicle factors. While there are many factors that contribute to crashes at Tahoe, the following five factors are the primary contributing causes of 75 percent of all fatal and serious crashes occurring in Tahoe:



Impaired Operating



Speed-related



Right of Way



Improper Turning



Lane departure

Impaired Operating

California SWITRS data does not report alcohol and drug use separately, instead reporting their influence in one category together. Whereas Nevada reports impairment for drug and alcohol separately. Impaired operating here refers to crashes with mention of driving under the influence, biking under the influence, drug involvement, or drivers that had been drinking. Some level of drug or alcohol influence was cited in approximately 21 percent of fatal and serious crashes.

Alcohol impairment is federally defined as a blood alcohol content (BAC) greater than or equal to 0.08 percent. States may enact stricter limits, such as Utah where the legal BAC was lowered to 0.05 percent in 2019. California and Nevada currently accept the federal limit of 0.08 percent for drivers over 21 years old and 0.04 percent for commercial vehicle drivers.⁷ There is no similar standard for driving under the influence of drugs. There are limitations in drug-detecting technology and a lack of an agreed-upon limit to determine impairment across states. The Center for Disease Control and Prevention notes that marijuana can impair important motor skills required to drive safely by slowing one's reaction time and ability to make decisions, impairing coordination, and distorting perception. Eighteen states have legal limits on the amount of tetrahydrocannabinol (THC) in your blood to be considered under the influence

⁷ Nevada Department of Motor Vehicles

of marijuana while driving.⁸ Nevada's per se law prohibits driving with a blood content of 2 ng/ml of THC and 5 ng/mg of THC metabolite. California law is not based on a set limit, but if the driver is under the influence of or affected by THC.

Law enforcement plays a strong role in reducing DUI crashes through enforcement, sobriety checkpoints, and media campaigns. Improving alternatives to driving, including fixed transit and microtransit, may also aid with reducing impairment crashes. The Countermeasure Toolbox includes strategies to improve transit safety, including bus pullouts and bus boarding islands. Education, public outreach, and enforcement also play a role in addressing impaired drivers. Infrastructure may play a role in reducing the severity of injuries in crashes related to driving under the influence. For example, a median island can reduce the risk of head-on collisions in the instance of an impaired driver departing the lane.

Speed-Related

The speed-related emphasis area combines similar categories from California and Nevada data, including driving too fast for conditions, exceeding speed limit, speeding, and unsafe speed. Speed was mentioned as a contributing factor in 47 fatal or serious crashes, making up 21 percent of fatal and serious crashes.

At higher speeds, drivers have less time to react to unexpected events or hazards and also must contend with longer stopping distances.

Drivers are also challenged in maintaining control of their vehicles, and high-speed crashes are more likely to result in vehicle rollovers. In the winter, driving too fast for conditions is often a contributing factor to crashes, as snow and ice on the road decreases traction and visibility. High speeds significantly increase the severity of crashes for all road users, but especially vulnerable road users without an outside shield.

The authority to set speed limits belongs to the state and local agencies with jurisdiction over the road. While TRPA does not have the authority to change speed limits, we are supportive of local and state efforts to reduce speeds to appropriate levels, particularly town centers and along recreation and commercial corridors, as detailed in Chapter 5: Proposed Strategies. It is important that traffic calming infrastructure is built before speed is reduced. Studies have shown that reducing the speed limit on a roadway has minimal impact on the operating speed of motorists unless the roadway conditions are designed for that lower speed limit. Furthermore, lower the speed limit without changes to the roadway may result in greater differences in speeds, resulting in more conflicts between vehicles.⁹ The

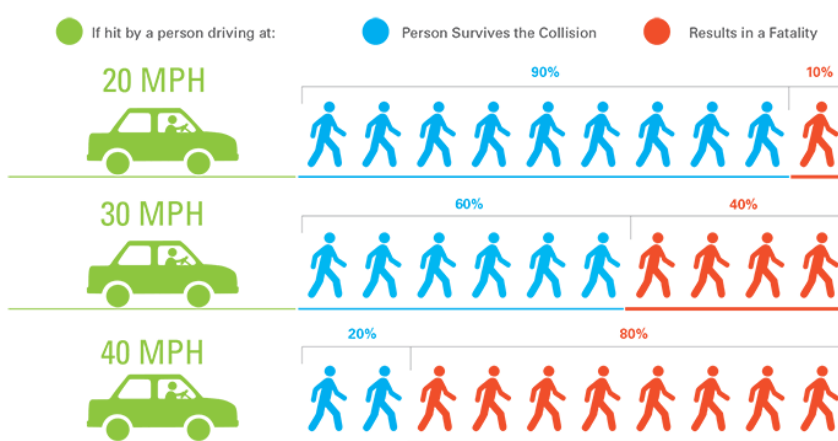


Figure 2.8. Source: Institute of Transportation Engineers

⁸ National Conference of State Legislatures

⁹ Oregon Department of Transportation

Countermeasure Toolbox includes engineering strategies aimed at reducing vehicle speeds, including roadway reconfigurations, roundabouts, dynamic speed feedback signs, and gateway signs. Following significant changes to the roadway context, such as changes in the number of lanes or changes in the configuration of bicycle lanes, state and local agencies should conduct engineering studies to reevaluate non-statutory speed limits.¹⁰

Right of Way

Right of way violation crashes are also referred to as failure to yield right of way or automobile right of way. Right of way violations are mentioned as a contributing factor in 33 fatal or serious crashes, representing 15 percent of fatal and serious crashes in the Tahoe Basin.

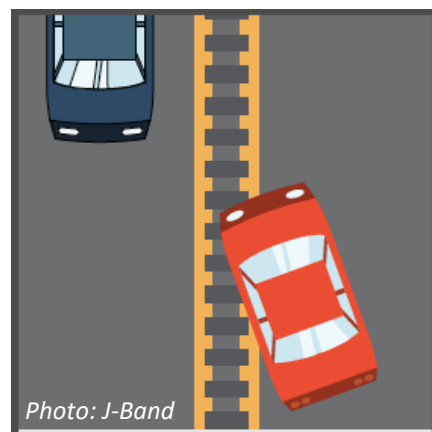
Right of way crashes occur when a driver fails to yield the right of way to another road user as required by traffic laws and regulations. Right of way crashes tend to occur at intersections, pedestrian crosswalks, and when merging or changing lanes. The Countermeasure Toolbox includes engineering strategies to design for right of way mistakes, such as a leading pedestrian interval to give pedestrians a head start in crossing the street, adaptive signal timing to extend the yellow light phase, and oversized warning signs to improve visibility. Education may also play a role in reducing right of way crashes, including educating students on the rules of the road in Safe Routes to School Programs.

Improper Turning

Improper turning crashes is a category only mentioned in the California crash dataset. Improper turning is the primary cause of 31 fatal or serious crashes, or 14 percent of all fatal and serious crashes in Tahoe. Improper turning crashes occur when a driver makes a turn that violates traffic laws or fails to execute a turn safely, leading to a collision with another road user. Improper turns include illegal turns, such as ignoring a “No Turn on Red” or “No U-Turn Sign” or failure to use turn signals. The Countermeasure Toolbox includes strategies to help reduce improper turning crashes, including directional median openings, bulb-outs, protected intersections, chevron signs on horizontal curves, and curve advance warning signs.

Lane Departure

The lane departure emphasis area refers to ran off road, failure to keep in proper lane, drove left of center, wrong side of road, and rollover/overtake. These lane departure actions are mentioned in 37 fatal or serious crashes or approximately 17 percent of all fatal and serious crashes. Proven safety countermeasures, including edgeline rumble strips, enhanced curve delineations, and median barriers can be used to keep vehicles in their lanes and increase survivability in the event of a lane departure. Newer vehicles include active safety measures to help prevent crashes, including lane departure warnings.



¹⁰ U.S. Department of Transportation Federal Highway Administration

2.4 Identification of Higher-Risk Locations

To understand and visualize road segments with the highest concentration of injuries, TRPA conducted a High Injury Network (HIN) analysis. SWITRS and NDOT crash data from 2013 to 2021 was used to produce HINs by mode for vehicle, pedestrian, and bicycle injuries in the Lake Tahoe Basin. The HIN methodology is outlined below.

1. **Initial Processing:** Crashes were geocoded according to the coordinates provided by each state for each incident. In the event coordinates were not provided or they were for a location outside of the street network, coordinates were estimated based on stated street locations. Crash descriptions were homogenized to the best extent possible to ensure that records for California and Nevada were equivalent, despite different reporting systems. For Nevada, this required adding fields to identify incidents involving bicyclists or pedestrians, as these were not called out in separate fields.
2. **Victims per Mile:** Injuries and fatalities were summed by mode of transportation for each segment and divided by the segment length to provide a “victims per mile” metric. Because Nevada does not report bicycle or pedestrian fatalities separately, TRPA summed the number of bike or pedestrian involved accidents for each segment and used that to calculate a “bike involved per mile” and “pedestrian involved per mile” metric.
3. **Segments Selected:** Segments were then selected in descending order of victims or crashes per mile until 65% of the total number of victims had been accounted for. These segments constituted the HIN for that mode of transportation. The table below shows how each HIN relates to the overall street network of the region. For example, 65% of all vehicle-involved only involved injuries occur on 6.69% of our roadways, which corresponds to 46 centerline miles.

High Injury Network	Percentage of Street Network	Miles of Street Network
Bicycle	1.73%	11.88
Pedestrian	1.02%	7.00
Vehicle	6.69%	46.00

Figure 2.9: High Injury Networks by percentage and miles of regional street network

The HIN analysis can be viewed in more detail on the [Vision Zero Website](#). TRPA’s methodology was largely based off the HIN methodology developed by the [Southern California Association of Governments](#) with adjustments to meet the context of Tahoe’s rural area. While many urban High Injury Network analyses only consider fatal and serious crashes, TRPA analyzed all injury crashes to include more data points and have segments with more statistical significance. The HIN analysis will be updated annually as new crash data is received from both states.

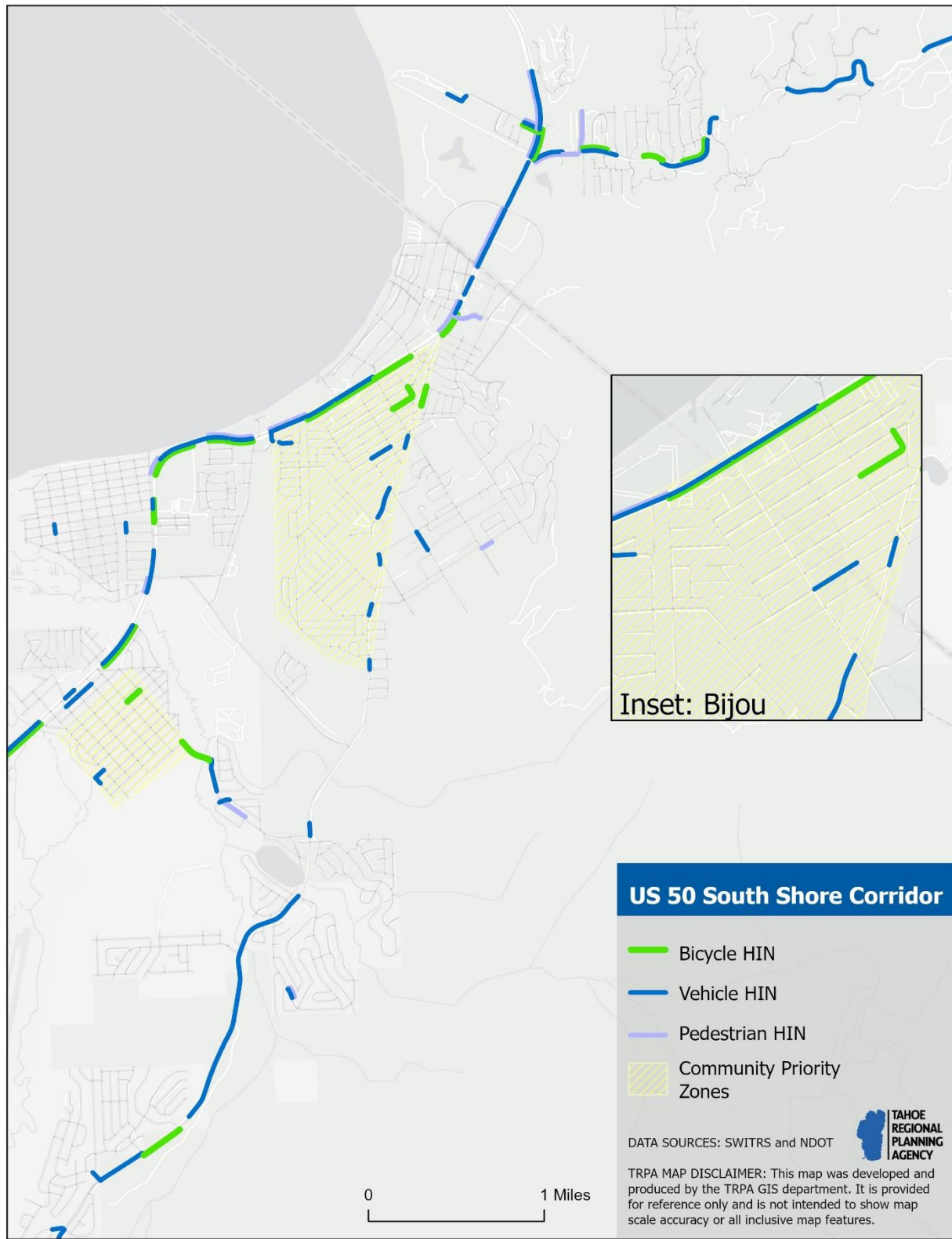


Figure 2.10: High Injury Network for the US 50 South Shore Corridor

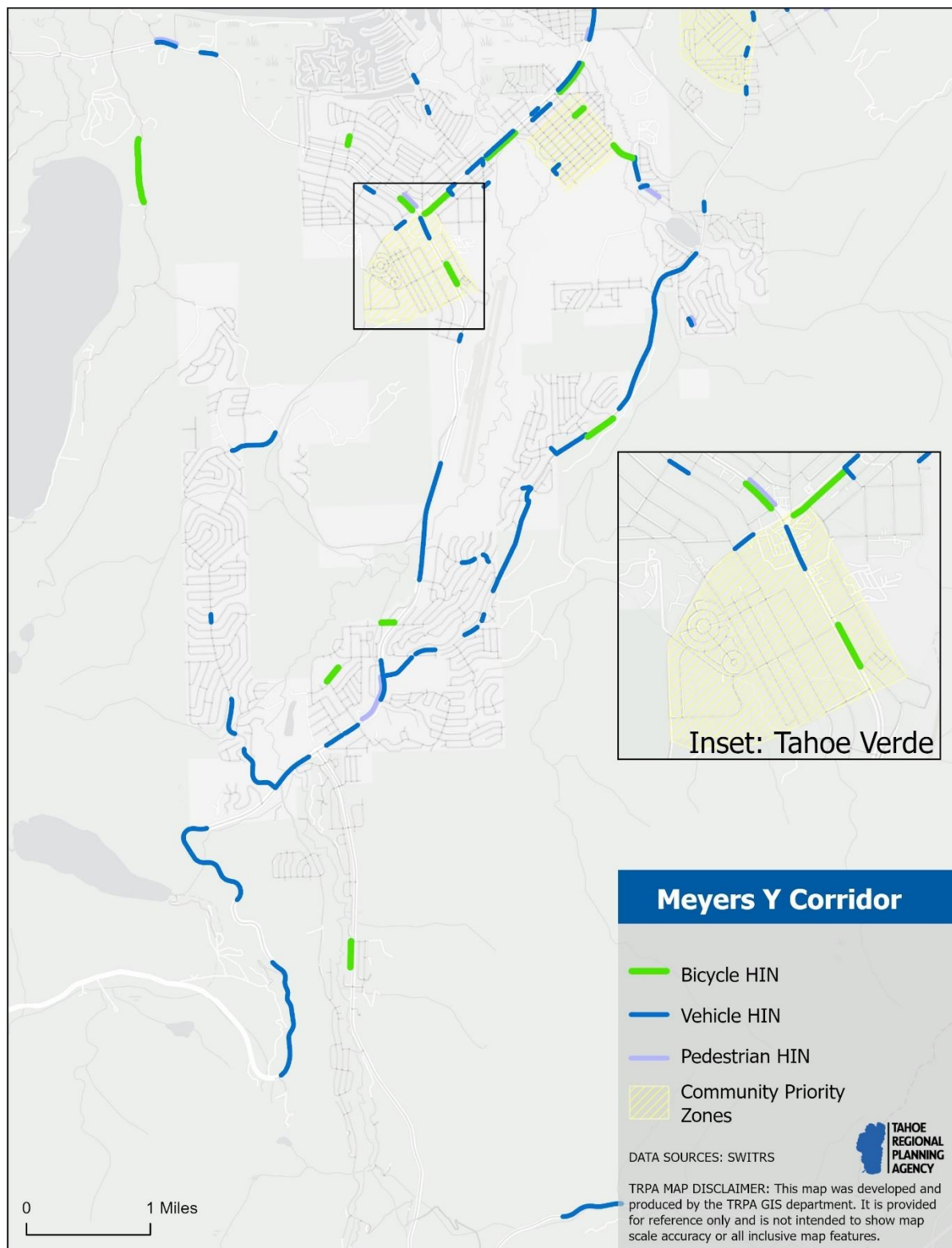


Figure 2.11: High Injury Network for the Meyers Y Corridor

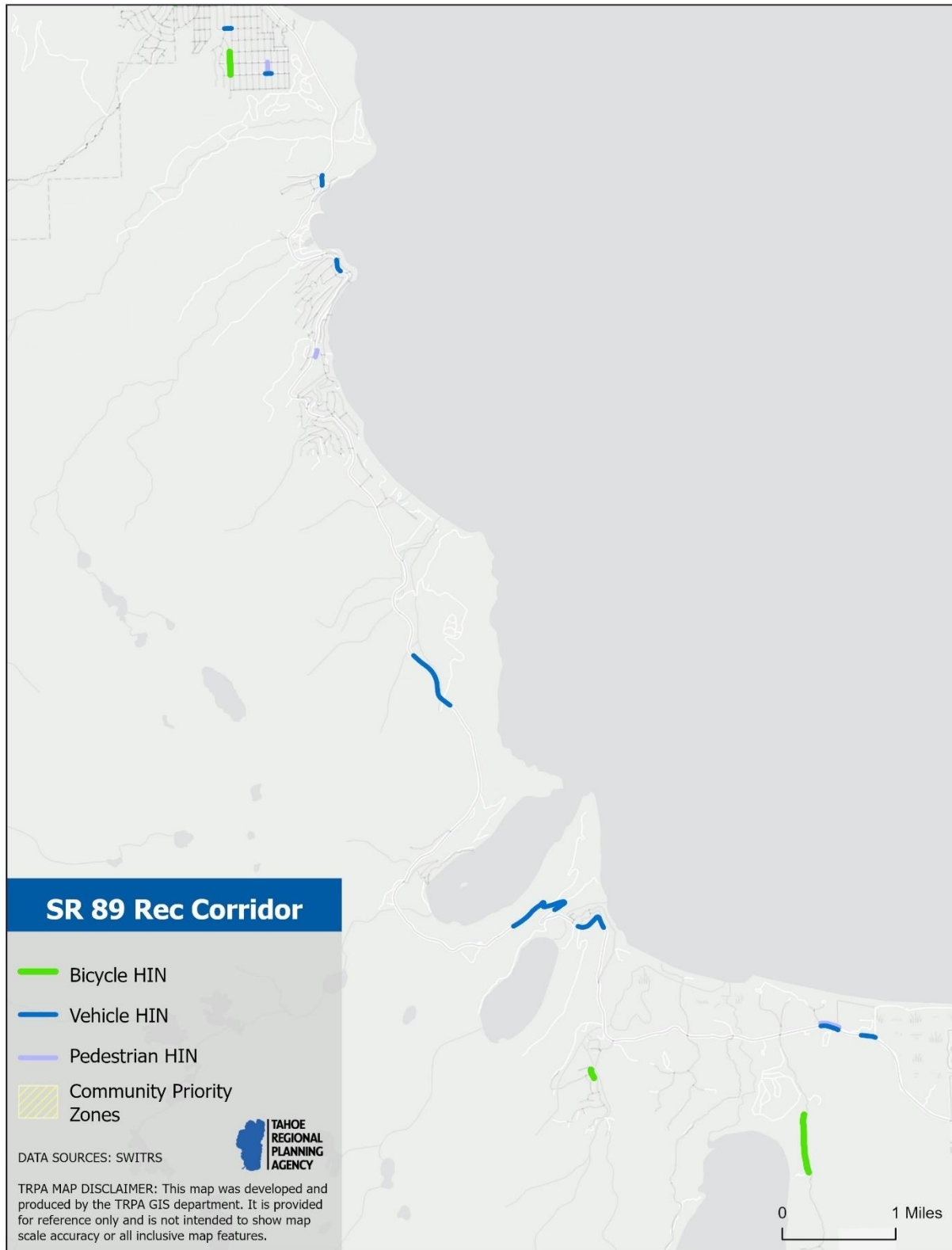


Figure 2.12: High Injury Network for the SR 89 Recreation Corridor

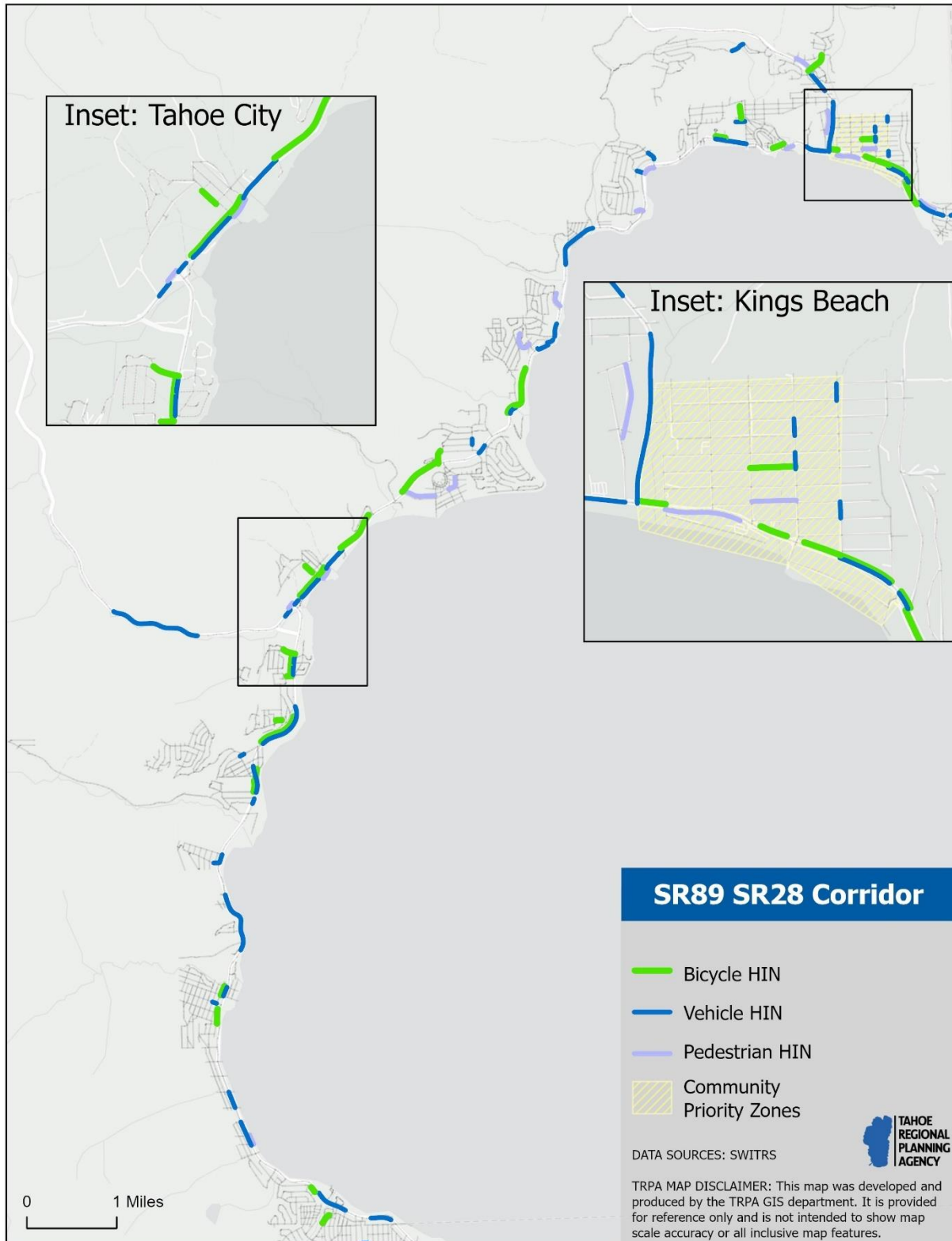


Figure 2.13: High Injury Network for the SR 89 SR 28 Corridor

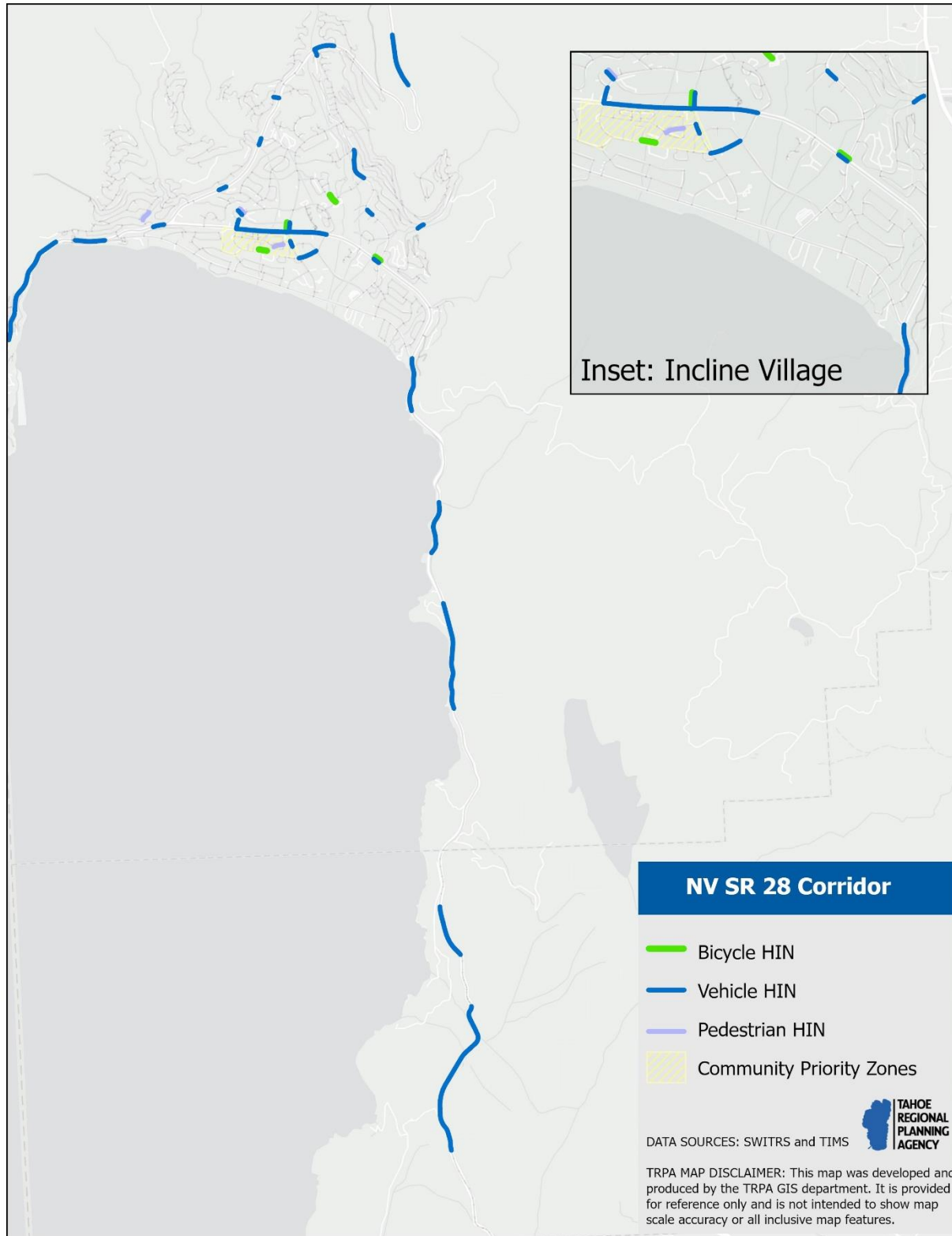


Figure 2.14: High Injury Network for the NV SR 28 Corridor



Figure 2.15: High Injury Network for the US 50 East Corridor

2.5 Supplemental Analyses to Support Vulnerable Road Users

While crash data is crucial to understand crash trends, TRPA recognizes that it does not always tell the full story. Crashes may go underreported, particularly those involving minor injuries or property damage only, there are delays in receiving crash data reports, and near miss incidents are not tracked. There may also be locations where people feel stress while traveling but have not been involved in a crash. Crashes involving vulnerable road users tend to be unreported more than crashes involving cars or trucks. A recent study in Washington D.C. found that on average 10 percent of car-only crashes go unreported, compared to 30 percent of car crashes involving a cyclist or pedestrian.¹¹

TRPA, with help from Cambridge Systematics, developed a supplemental traffic stress analysis to fill part of this gap, the Bicycle Level of Traffic Stress (BLTS) Analysis. Traffic stress analyses are useful for understanding how comfortable a specific roadway segment within the transportation network feels for a person traveling along or across a given location. The BLTS focused specifically on the level of stress that bicyclists might experience when traveling on a particular street, intersection, or other bicycle facilities. The BLTS considered the following factors for each road segment: maximum speed limit, number of lanes, traffic volume, functional class of the road, existing bicycle facilities, roadway width, and one-way designations. The BLTS also quantified bicycle experience at each intersection, examining whether the intersection is signalized, if a median is present, number of travel lanes, and functional class. The factors were all calculated into a weighted score, giving each intersection and segment a score from 1 to 4 as described below:

BLTS 1: low-stress, all ages and abilities

- Roadway and intersection crossings would be comfortable for children and traffic intolerant.

BLTS 2: moderately low-stress, interested but concerned

- These locations would be comfortable for people that are interested in cycling but concerned about the safety and stress of bicycle riding within the transportation network.



¹¹ Bliss

BLTS 3: moderately high-stress, enthusiastic and confident

- These locations would be comfortable for the enthused and confident rider types.

BLTS 4: high-stress, strong and fearless

- These locations would be comfortable for only the strong and fearless.

BLTS 4.5: exceptionally high-stress, strong and fearless

- These locations are typically narrow roads with high speeds and small or no shoulder where strong and fearless cyclists must take the travel lane.

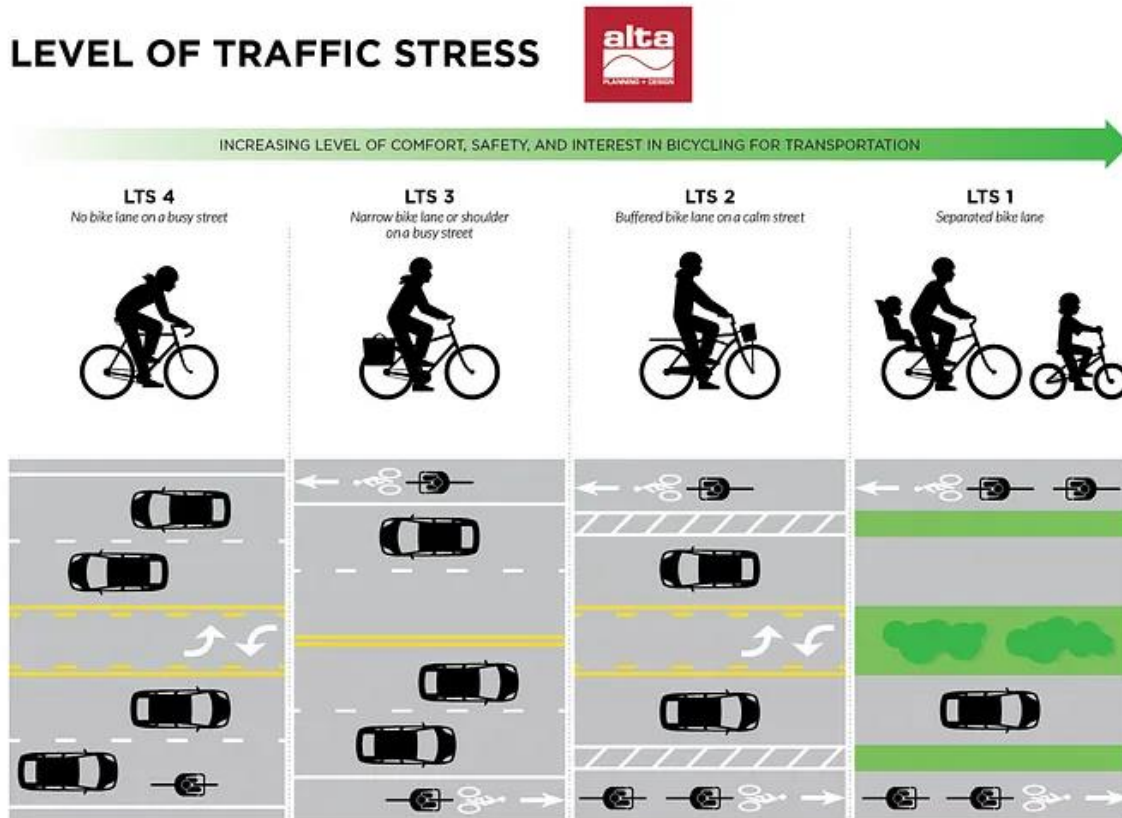


Figure 2.16: Level of Traffic Stress. Source: Alta

The 2024 Active Transportation Plan (expected March 2024) will include a complimentary Pedestrian Experience Index (PEI). The PEI considers the roadway characteristics and the built environment to provide an overall walkability score. This score aims to capture the full experience for pedestrians, not just the level of stress. The PEI scores also consider infrastructure, street design, community activity, and economic activity.

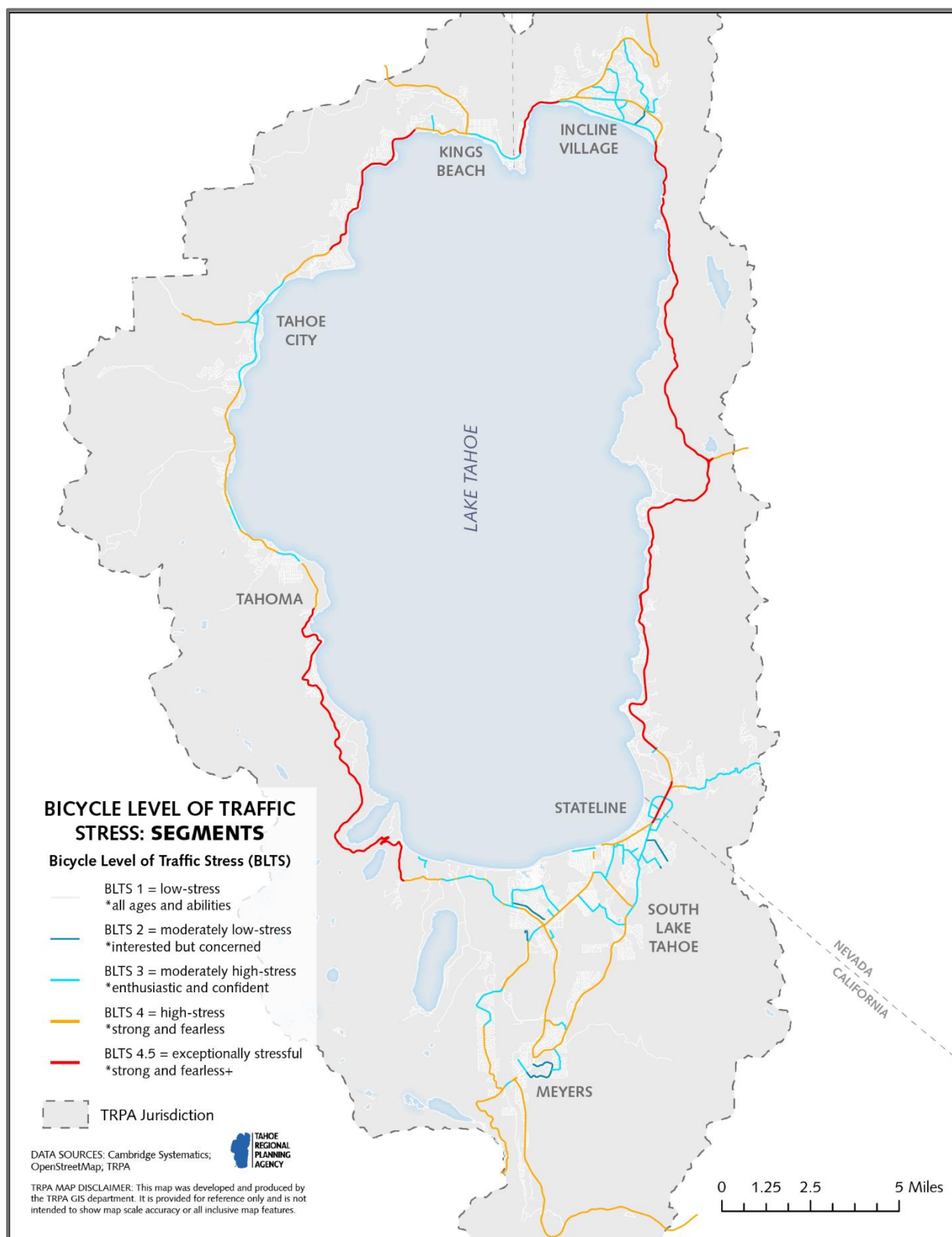


Figure 2.17: Bicycle Level of Traffic Stress Segments

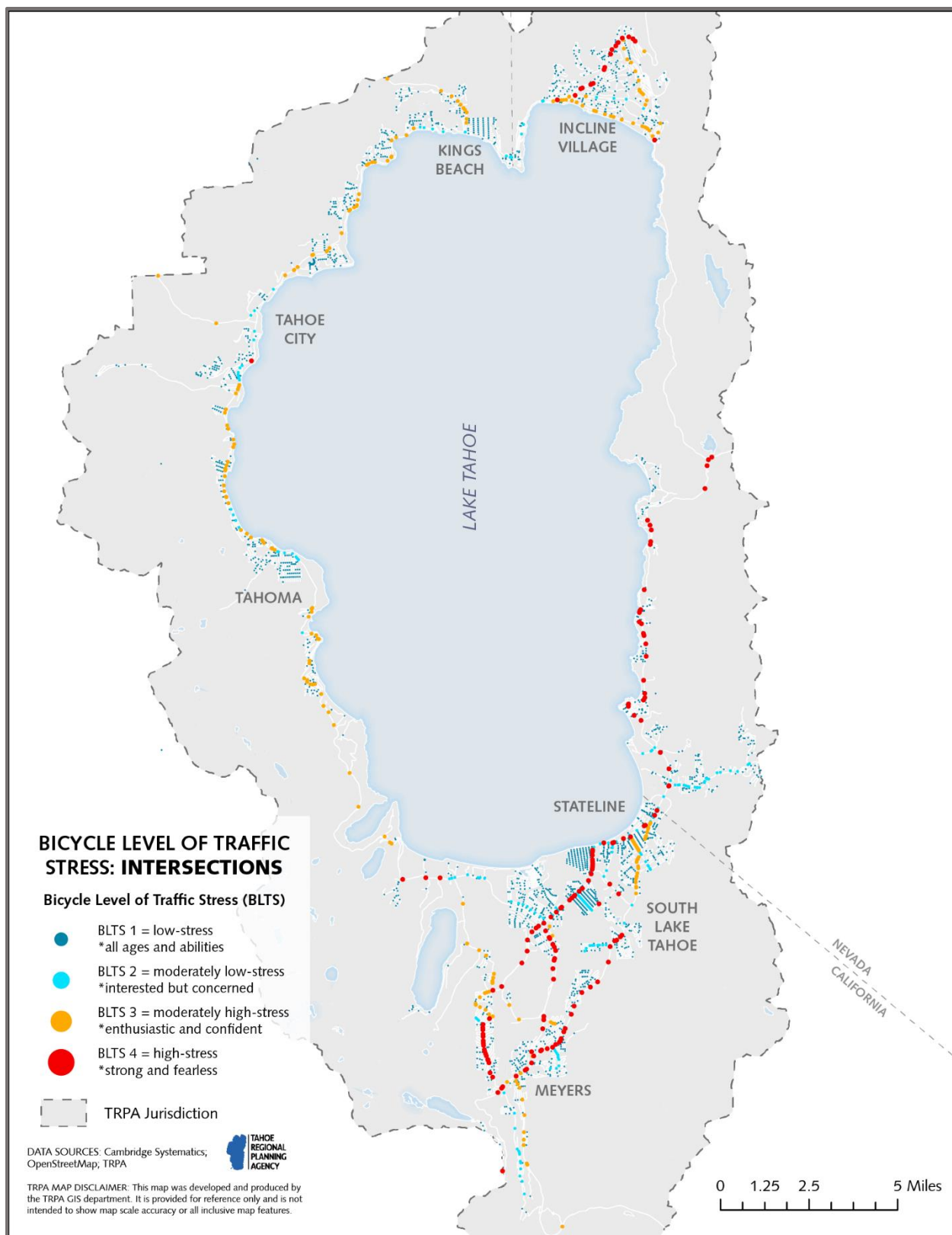


Figure 2.18: Bicycle Level of Traffic Stress Intersections

2.7 Missing Data

Micromobility Users

Micro mobility users (electric scooters, electric bikes, etc.) have increased significantly since the last Safety Strategy. Micro mobility offers an environmentally friendly alternative to driving. However, these modes also bring a potential for conflict with an additional mode at a different speed sharing Class 1 paths and bicycle lanes. There is also a potential for conflict with pedestrians on sidewalks if users are not properly educated on California law that e-scooters are illegal on sidewalks. Unfortunately, there is a lack of crash data available for collisions involving micro mobility users to report on any conflicts or crashes, but TRPA identifies this as an important area for future investigation.

Micro mobility users are considered vulnerable road users, as they are not protected by an outside shield, and ensuring the safety of these road users is important moving forward. The 2024 Active Transportation Plan will share additional information and resources on e-bikes and e-scooters to help educate on the current policies in the Lake Tahoe Basin. The map on the right shows the 2022 trip density of Lime e-scooters in the South Shore area, with over 140,000 trips made between May and October.

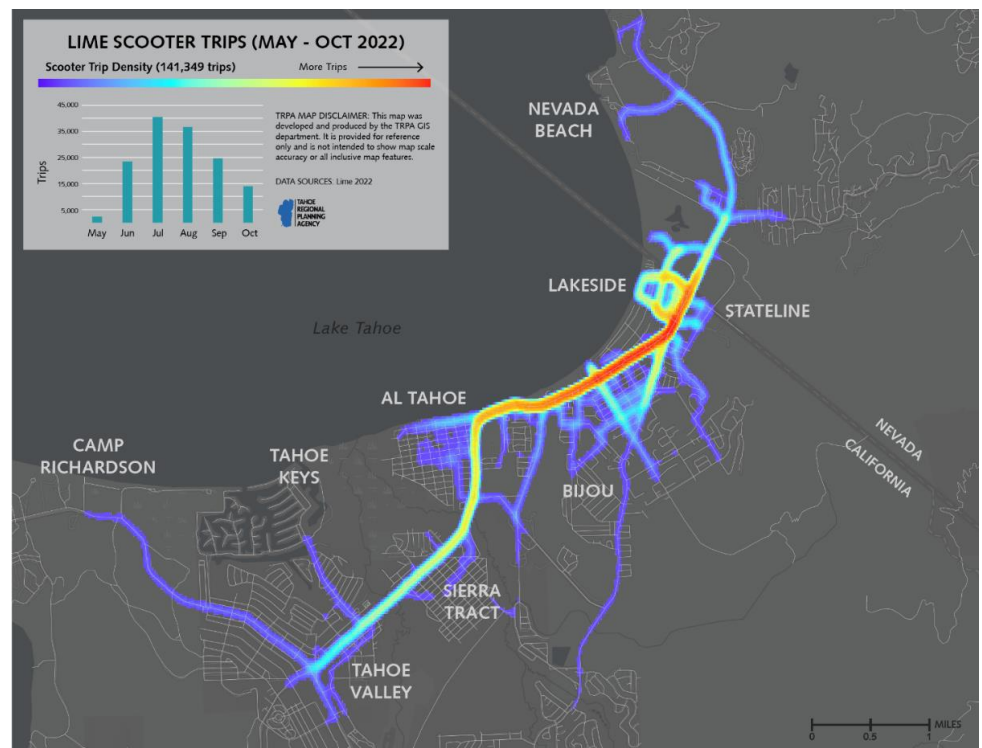


Figure 2.19: Heat map illustrating the scooter usage patterns in 2022 for the South Shore. Source: Lime.

Wildlife Collisions

Crashes involving wildlife tend to be unreported to statewide crash databases unless a human is injured in the crash or the vehicle becomes undriveable. While Vision Zero focuses specifically on reducing fatalities and serious injuries for humans, safety infrastructure that provides traffic calming or improves sightline visibility may also benefit wildlife. The Wildlands Network and Pathways for Wildlife, funded by a grant from the California Tahoe Conservancy, are conducting a multi-year study of wildlife connectivity in the California portion of the Lake Tahoe Basin. This study will be identifying additional sources of wildlife collision data and collaborating with transportation agencies. Learn more about the wildlife connectivity study at: <https://www.laketahoeinfo.org/Project/Detail/4491>.

3.0 PUBLIC ENGAGEMENT

Meaningful public engagement and education is a key part of Vision Zero. TRPA conducted extensive public outreach from April through September 2023, including in-person engagement and an online survey.

Outreach for this strategy incorporated recommendations and best practices from the 2023 Transportation Equity Study, including translating materials to Spanish, place-based engagement in underserved communities, outreach at existing community events to reduce barriers to participation, and combining outreach with concurrent TRPA planning efforts to reduce survey fatigue. Staff attended existing community events, including Earth Day festivals, Tahoe Bike Month events, the Tahoe Area Mountain Biking Association (TAMBA) mountain bike festival, farmers markets, the Lake Tahoe Summit, and various free community concerts. Two Spanish-speaking workshops were held, one on the South Shore with the Family Resource Center and one on the North Shore with the Sierra Community House. At all the in-person events, staff talked to approximately 430 people about Vision Zero and heard about community perceptions of safety.

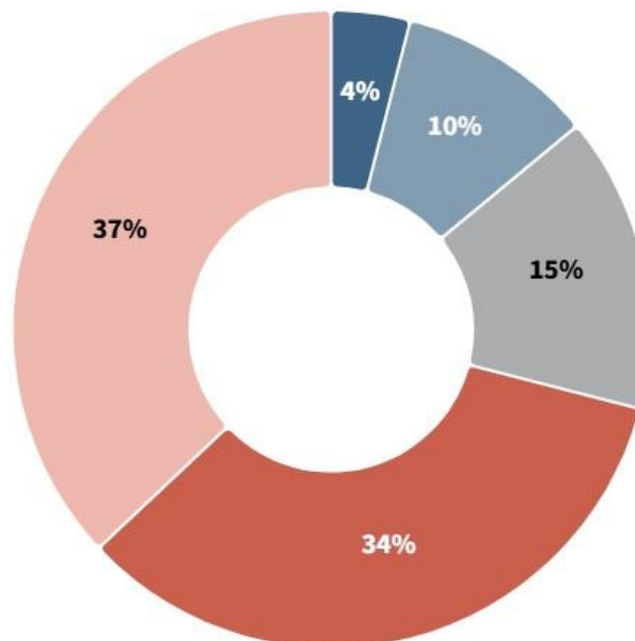
The survey included questions and an interactive map, available in both English and Spanish and paper copies available at in-person events. For a list of all of the questions we asked, see Appendix D

3.1 Key Survey Takeaways:

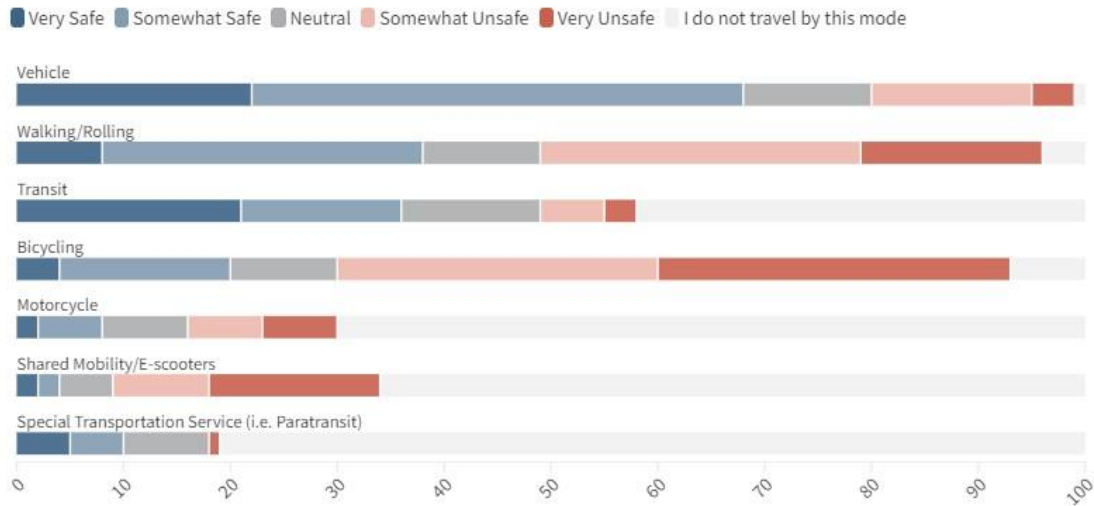
We asked people how they felt about the following statement:

The Lake Tahoe Region is a safe place for all road users—motorists, bicyclists, and pedestrians—to travel. (N = 238)

■ Strongly Agree ■ Agree ■ Neutral ■ Disagree ■ Strongly Disagree

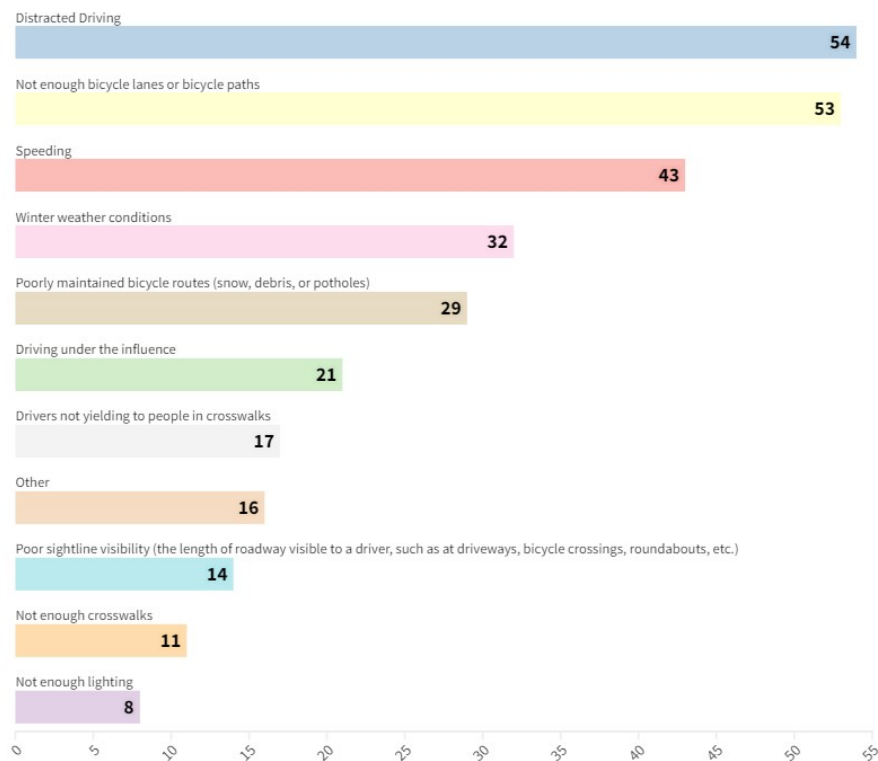


We asked people how safe they feel travelling by each of these modes:
(N = 241)



People felt the safest travelling by vehicle, transit, and paratransit, and the least safe by walking/rolling, bicycling, and shared mobility/e-scooters. This sentiment is in line with the crash data that shows vulnerable road users are disproportionately involved in serious and fatal crashes.

What are your biggest safety concerns while travelling in the Tahoe Region?
(N = 242)



In addition to the above safety concerns, we heard the community wanted:

- More crosswalks and improvements to existing crosswalks to improve driver yielding rates
- Bicycle lanes with buffers (vertical or horizontal) to provide protection from passing vehicles
- Improved street maintenance (sweeping, pothole repair, striping, sidewalk, and bicycle lane snow removal)
- Safer crossings where Class 1 paths end, or where there are common street connections to Class 1 paths
- Safer routes to school for active modes
- Guidance and education needed on scooters and e-bike usage
- Solutions to highway shoulder parking



Photo: Ryan Murray

4.0 EQUITY

Equity is weaved throughout this strategy, including public engagement strategies, incorporation of Community Priority Zones in the High Injury Network, proposed policies, and project selection criteria. Using an equity-centered approach in Vision Zero planning ensures that all individuals, regardless of their socio-economic background, race, age, or ability, have equal access to safe transportation and that safety projects within disadvantaged communities are prioritized for funding and implementation.

4.1 Identification of Underserved Communities

This Vision Zero strategy comes on the heels of the first ever Transportation Equity Study for the Lake Tahoe Region, which was completed and endorsed by the TRPA Governing Board in 2023. [The Transportation Equity Study](#) identified existing transportation barriers for identified priority communities at Lake Tahoe. The first step was to conduct a demographic analysis of the region, based on U.S. Census Data. Community Priority Zones are defined as neighborhoods with higher densities of at least three of the following demographic characteristics:

- **Persons without private transportation (zero vehicle households):** Lack of a personal vehicle is a significant factor for transit need. In 2022, 80 percent of Tahoe transit riders did not have access to a personal vehicle.
- **Seniors (individuals 65 years and older):** Elderly individuals may choose not to drive or can no longer drive due to age.
- **Persons living below the poverty line:** Purchasing and maintaining a personal vehicle might be difficult for households with limited income.
- **Individuals with a disability:** Disability status may impact an individual's ability to live independently, including driving a personal vehicle.
- **Youth (individuals under 18 years old):** Most people under 18 do not drive and even those with driver's licenses often do not have the means to purchase or maintain a personal vehicle.
- **BIPOC (Black, Indigenous, and People of Color):** People of color are more likely to live in densely populated areas, are less likely to have access to a car, and are more likely to bike, walk, and use public transportation to commute to work.

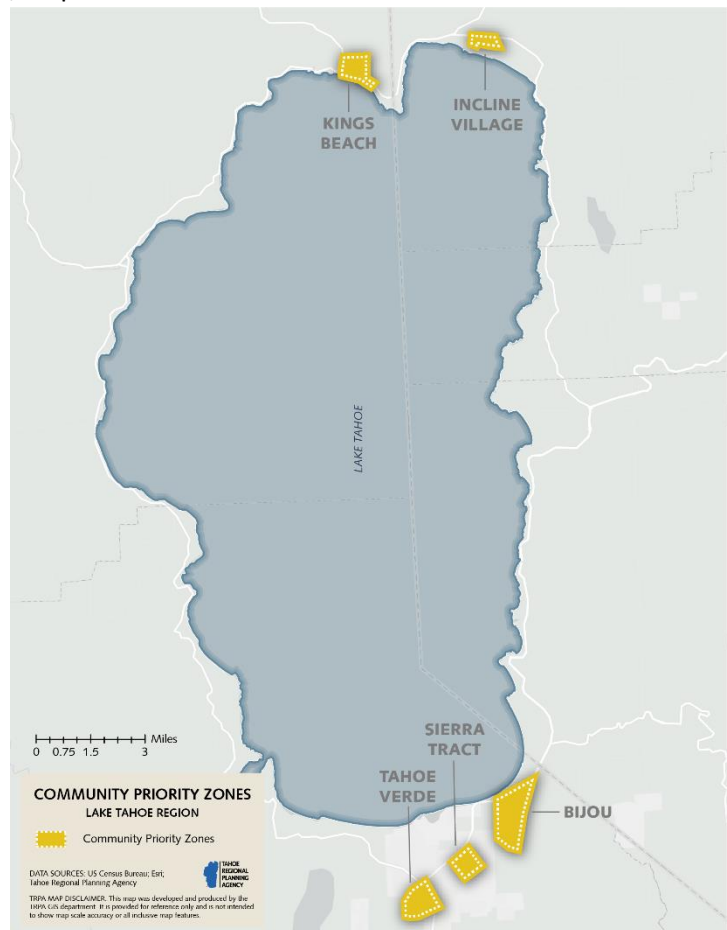


Figure 4.1: Community Priority Zones

4.2 Equity in Vision Zero

The following benefits may be realized when transportation equity is a fundamental consideration in the planning and implementation of Vision Zero and roadway safety strategies and projects.



Reducing Disparities: Low-income communities and minority populations are disproportionately affected by traffic crashes and fatalities. By prioritizing equity, Vision Zero aims to reduce these disparities by investing in safer infrastructure and policies that benefit these vulnerable communities. Achieving equity in transportation planning is an essential step towards rectifying these historical inequities.



Encouraging Active Transportation: Equitable roadway safety planning encourages the use of active transportation modes, such as walking and cycling. These modes are particularly important for individuals who may not have access to private vehicles. By providing safe infrastructure and accessible routes, Vision Zero promotes active transportation, leading to improved public health, reduced emissions, and enhanced community well-being.



Fostering Social Inclusion: Equitable transportation planning supports the social inclusion of marginalized groups and individuals with disabilities. It ensures that transportation systems are accessible, allowing all members of the community to participate in economic, educational, and recreational activities. Vision Zero seeks to eliminate barriers that prevent people from enjoying the benefits of safe transportation, thereby fostering social cohesion and inclusivity.



Enhancing Economic Opportunities: A transportation system designed with equity in mind can increase economic opportunities for underserved communities. Improved access to jobs, education, and healthcare through safe and affordable transportation can empower individuals and communities, ultimately contributing to economic growth and reducing income disparities.



Reducing Conflicts with Law Enforcement: Vision Zero planning helps reduce potential conflicts with law enforcement for people of color by addressing the systemic issues of over-policing and racial profiling. Through its focus on safer road infrastructure, equitable enforcement practices, and community engagement, Vision Zero aims to create a transportation system where safety is the primary goal, rather than punitive measures. This shift in emphasis reduces the opportunities for traffic stops and interactions with law enforcement that can lead to discriminatory practices and conflicts, promoting a fair and just approach to road safety for all individuals, regardless of their racial or ethnic background.



Building Public Support: Transportation equity plays a crucial role in gaining public support for Vision Zero initiatives. When all community members see that safety improvements are designed with their interests in mind, they are more likely to engage in and support these projects. Public backing is essential for the successful implementation of Vision Zero strategies.

5.0 PROPOSED STRATEGIES

TRPA has identified the following strategies to promote Vision Zero, within the realm of our roles and responsibilities as a regional planning agency and as the MPO for the region, identified in Chapter 2.0. The strategies have been developed in line with the Transportation Equity Study's recommendations.

5.1 Policies Strategies

	Action:	Consider adoption of revised safety policies in the future 2025 Regional Transportation Plan.
	Timeframe:	Fall to Winter 2024
	Goal:	Ensure safety is a priority in the next Regional Transportation Plan, which sets long term goals for the region with a 25-year planning horizon.

5.2 Planning & Coordination Strategies

	Action:	Encourage partner implementation of safety priority projects and utilization of the Countermeasure Toolbox (appendix A) for safer designed streets. Commit to update the toolbox as needed to accelerate implementation with the partners.
	Timeframe:	Standing agenda item biannually at Tahoe Transportation Implementation Committee Meetings and quarterly one-on-one check-ins with local implementation agencies. Review Countermeasures Toolbox every four years and consider update.
	Goal:	Provide a toolbox of recommended Tahoe appropriate proven safety infrastructure countermeasures. The Tahoe Transportation Committee includes all agencies in the basin that implement safety projects. This group will be tasked with the implementation of Vision Zero projects.

	Action:	Coordinate with local jurisdictions to encourage adoption of Vision Zero goals and policies.
	Timeframe:	Ongoing. Currently coordinating with the City of South Lake Tahoe on their Vision Zero Plan.
	Goal:	Develop a unified approach to traffic safety in the Tahoe Basin.

	Action:	Track and support local and state efforts to reduce speeds to appropriate levels.
	Timeframe:	Ongoing
	Goal:	Appropriate speeds in town centers and along recreation and commercial corridors, aligning with the goals of Vision Zero and the Regional Transportation Plan.

5.3 Program Strategies

	Action:	Continue empowering Safe Routes to School programs throughout Lake Tahoe.
	Timeframe:	Summer 2024
	Goal:	Work with school districts around the lake to implement Safe Routes to School programming and identify local champions to assist in implementation of the program. Empower students to feel safe walking, biking, and rolling to school. Aim to reach a wider audience of elementary school students in the region.

	Action:	Continue involvement with Take it Slow, Tahoe campaign , including additional lawn sign and banner distribution.
	Timeframe:	Ongoing, additional distribution planned for 2024
	Goal:	Support campaigns that help improve safety for all.

	Action:	Work with local and regional news outlets to provide education on the principles of Vision Zero and the role of media in changing the narrative. For example, referencing “crashes” rather than “accidents” to support the narrative that crashes are preventable.
	Timeframe:	Ongoing, beginning in 2024
	Goal:	Bring the media in as a partner in Vision Zero and highlight their role in educating the public and advancing the regional Vision Zero goals.

5.4 Funding Strategies

	Action:	Revise the Regional Grant Program guidelines and supplemental Project Assessment to reflect the updated crash data and Vision Zero priorities.
	Timeframe:	Prior to next Regional Grant Program cycle in 2025
	Goal:	Align TRPA Regional Grant Program with Vision Zero to ensure TRPA is funding projects that will improve roadway safety for all users.

	Action:	Support local grant applications for safety projects, including but not limited to the next SS4A cycle. See Appendix B for a list of safety funding opportunities.
	Timeframe:	Ongoing
	Goal:	We understand to achieve the goal of Vision Zero, the region needs more transportation safety projects implemented, and for those to get implemented, local agencies need funding. Increase awarded competitive funding for safety projects.

5.5 Permitting Strategies

	Action:	Review TRPA's permitting policies and identify any areas of improvement to streamline transportation safety projects.
	Timeframe:	By Jan 2026
	Goal:	Identify and reduce barriers to implementation of transportation safety projects.

	Action:	Reexamine project review process and consider establishing a Vulnerable Road User/Vision Zero project review checklist or guide for TRPA and local agency review processes.
	Timeframe:	By June 2025
	Goal:	Ensure principles of Vision Zero remain a priority despite any agencies staff turnover by formalizing it into the transportation project review process. Ensure consistency and continuity in implementing road safety measures across different jurisdictions.

5.6 Data & Monitoring:

	Action:	Complete the Federal target setting requirement for Safety Performance Measures, TRPA as the MPO must set a target for each of the 5 HSIP Safety Performance Measures.
	Timeframe:	Annually
	Goal:	Track progress and identify any appropriate actions that TRPA can do to improve safety performance

	Action:	Investigate opportunities to receive crash data faster, potentially directly from local and state law enforcement agencies. Stay in sync with Caltrans and NDOT efforts to improve crash data reporting process.
	Timeframe:	Fall 2023 to Summer 2024
	Goal:	Reduce lag in receiving crash data so that unsafe locations can be identified and improved more quickly by partner agencies.

	Action:	Update the Crash Data Dashboard and High Injury Network analysis on the Vision Zero website with the most up-to-date crash data. Display progress toward reducing roadway fatalities and serious injuries on the Vision Zero website.
	Timeframe:	Product and task of the annual Transportation Overall Work Program (OWP).
	Goal:	Provide transparency to the public and stakeholders. Provide current data to improve decision making and sustain safety investments.

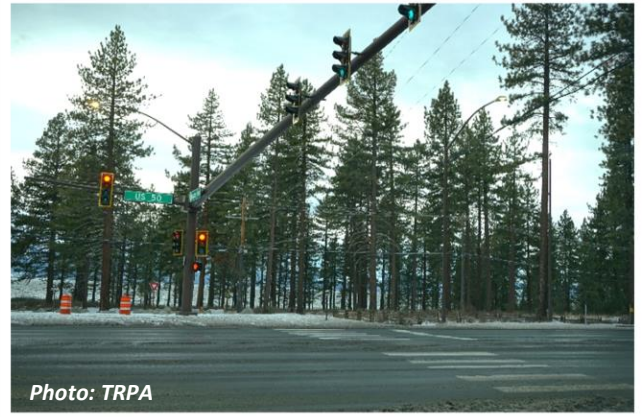
	Action:	Report to the TRPA Governing Board on status and progress of Vision Zero.
	Timeframe:	Biennially
	Goal:	Method to measure progress over time after the strategy is developed and provide transparency to the public. Provides the Governing Board with information for transportation decision making.

6.0 PROJECT RECOMMENDATIONS

6.1 Progress Highlights Since 2019:

Warrior Way & US 50 Intersection

- Identified as a candidate intersection for safety improvements in 2019 Safety Strategy.
- NDOT installed a traffic signal with a pedestrian crossing, sidewalks from the intersection into Zephyr Cove, and a stormwater basin and drainage improvements. NDOT also added no-parking signs and plans to further remove roadside parking.
- Project constructed in Summer – Fall 2023.



Kahle Complete Streets Project

- Kahle Drive identified as a priority project in 2019 Safety Strategy.
- Project will transform Kahle Drive into a complete street by improving drainage, adding sidewalks, bicycle lanes, crosswalks, a safe intersection, and undergrounding overhead utilities.
- Construction expected Summer 2024.

Photo: NTCD, Vision for Kahle Complete Streets



Pioneer Trail at Edna Street

- Identified as a priority project in 2019 Safety Strategy.
- City of South Lake Tahoe received HSIP funds to install dynamic speed feedback signs, edge-lines and centerlines at intersections, intersection warning signs for minor streets, intersection lighting, upgraded pavement markings, and widen shoulder.
- Undergoing planning/design.

Photo: Wood Rodgers, 2019 Safety Strategy



6.2 Project List

TRPA seeks to support local jurisdictions in identifying and implementing projects that reduce crash frequency and severity. Projects have been selected in conjunction with local implementors and based on the following criteria. Projects from the 2019 Safety Strategy that have not been implemented were re-evaluated against the new criteria to determine if they would remain on the list.

1) High Injury Network (HIN) analysis:

Any portion of the project is on the vehicle, bicycle, or pedestrian HIN. The HIN identifies stretches of roadways with the highest concentration of injuries occurring.

2) Equity:

The project is fully or partially within a regionally defined [Community Priority Zone](#).

3) Bicycle Level of Traffic Stress Analysis:

The project is on a segment or intersection with a level of traffic stress greater than or equal to 3. A score of 3 indicates a moderately high-stress environment where only experienced and confident bicyclists may feel comfortable, a score of 4 indicates a high-stress environment where only the most confident and skilled bicyclists would attempt to ride, and a score of 4.5 is exceptionally stressful where only strong and fearless bicyclists would navigate. While the BLTS analysis aims to quantify stress for bicyclists, the criteria are based on roadway characteristics that are relevant for other road users, particularly the most vulnerable road users, including speed limit, traffic volume, and number of lanes. Including the BLTS analysis in the project selection criteria helps capture potential high-risk locations where vulnerable road users experience high stress. This helps proactively implement projects where safer infrastructure is needed, even if crashes have not yet occurred at that location.

Not every segment that met the above criteria was possible to include in the project list. Segments that met selection criteria were considered in context with the crash data, contributing crash types at that location, public input, and projects recently implemented that may not be reflected in data yet. Public feedback from the interactive survey map also informed project selection. For example, pedestrian improvements at Apache Avenue were identified by several people as a location that feels unsafe to cross. Candidate locations were evaluated from a regional perspective, considering regional transportation needs, connectivity to and from Tahoe and outside the region, major activity centers in the region, high demand recreation facilities, and transportation hubs. Locations not on the list may still be identified for safety improvements by local and state implementing agencies.



30 Candidate Project Locations:

A total of 30 candidate locations were identified on the project list. Eight of these 30 locations have been identified as priority projects, denoted in red below.

Candidate Location <i>(Priority Projects in red)</i>	Lead Agency or Agencies	Timeframe <i>(0-5 years, 5-10 years, or 10+ years)</i>	Project Selection Criteria			Connections to Existing Plans & Projects
			<i>High Injury Network</i>	<i>Community Priority Zone</i>	<i>Level of Traffic Stress ≥ 3</i>	
City of South Lake Tahoe						
Pioneer Trail from Ski Run Blvd to Price Rd	City of South Lake Tahoe	5-10 years				
US 50 from Pioneer Trail to Stateline Ave	City of South Lake Tahoe & Caltrans	5-10 years				Main Street Management Plan
Tamarack Ave & Blackwood Rd intersection	City of South Lake Tahoe	0-5 years				Ski Run Mountain to Marina Green Infrastructure
El Dorado County						
Lake Tahoe Blvd from Industrial Ave to Boulder Mountain Ct	El Dorado County	0-5 years				El Dorado Local Roadway Safety Plan
North Upper Truckee Rd at W San Bernardino Ave	El Dorado County	5-10 years				2019 TRPA Safety Strategy
Pioneer Trail from High Meadow Trail to Marshall Trail	El Dorado County	5-10 years				
Black Bart Ave, turning into Martin Ave, to intersection with Barbara Ave	El Dorado County	0-5 years				
Placer County						
SR 28/N Lake Blvd, Beach St to Secline St including SR 28 & SR 267 intersection & SR 267 to Dolly Varden Ave	Placer County	0-5 years				Kings Beach Western Approach Project
SR 28 from Chipmunk St to Stateline	Placer County	5-10 years				
SR 28 from Mackinaw Rd to Sierra Terrace Rd	Placer County & Caltrans	0-5 years				Tahoe City RSA
SR 89 from Tahoe Ski Bowl Way to Trout St	Placer County	5-10 years				

Candidate Location <i>(Priority Projects in red)</i>	Lead Agency or Agencies	Timeframe <i>(0-5 years, 5-10 years, or 10+ years)</i>	Project Selection Criteria			Connections to Existing Plans & Projects
			High Injury Network	Community Priority Zone	Level of Traffic Stress ≥ 3	
Washoe County						
SR 28 from Lakeshore Blvd to Beowawie Rd	Washoe County	5-10 years				SR28 Corridor Management Plan
Caltrans						
US 50 at F St to SR 89 at 10 th St	Caltrans	5-10 years				Caltrans Road Safety Audit
US 50 from Old Meyers Grade Rd to Echo Summit Rd	Caltrans	0-5 years				
US 50 from Apache Ave to Hopi Ave	Caltrans	0-5 years				Apache Avenue Complete Streets Project
SR 89 from Cascade Lake Rd to Upper Emerald Bay FS Rd	Caltrans	10+ years				SR 89 Recreation Corridor Management Plan
SR 28 at Old Country Rd	Caltrans	0-5 years				
SR 267 from Brockway Summit to East of Brockway Summit Trailhead	Caltrans, Placer County	0-5 years				Resort Triangle Transportation Plan Brockway West Trailhead Rebuild
SR 89, West of Twin Craggs Segment	Caltrans	10+ years				Resort Triangle Transportation Plan
NDOT						
SR 28 from Southwood /Northwood Blvd East to Southwood /Northwood Blvd West	NDOT	5-10 years				Washoe County Transportation Plan
US 50 from Lake Parkway to SR 207 intersection	NDOT, TTD	0-5 years				US 50/South Shore Community Revitalization
US 50 from Stateline Ave to Lake Parkway, including Lake Parkway intersection	NDOT, TTD	5-10 years				Main Street Management Plan US 50/South Shore Community Revitalization
US 50 from SR 207 intersection to just North of Kahle Drive	NDOT	0-5 years				
SR 207 at S Benjamin Dr	NDOT	5-10 years				2019 TRPA Safety Strategy

Candidate Location <i>(Priority Projects in red)</i>	Lead Agency or Agencies	Timeframe (0-5 years, 5-10 years, or 10+ years)	Project Selection Criteria			Connections to Existing Plans & Projects
			High Injury Network	Community Priority Zone	Level of Traffic Stress ≥ 3	
SR 207 from Palisades Rd to Tudor Ln	NDOT	5-10 years				2019 TRPA Safety Strategy
SR 207 from Logging Road Lane to Buchanan Rd	NDOT	5-10 years				2019 TRPA Safety Strategy
US 50 from Lakeview Drive to Church St	NDOT	0-5 years				2019 TRPA Safety Strategy US 50 East Shore Corridor Management Plan
US 50 from Hidden Woods Dr to north side of tunnel	NDOT	5-10 years				2019 TRPA Safety Strategy US 50 East Shore Corridor Management Plan
SR 28 & US 50 Intersection (Spooners Summit)	NDOT	5-10 years				2019 TRPA Safety Strategy US 50 East Shore Corridor Management Plan
SR 28 from Thunderbird Cove to Secret Harbor	NDOT, TTD	0-5 years				SR28 Corridor Management Plan

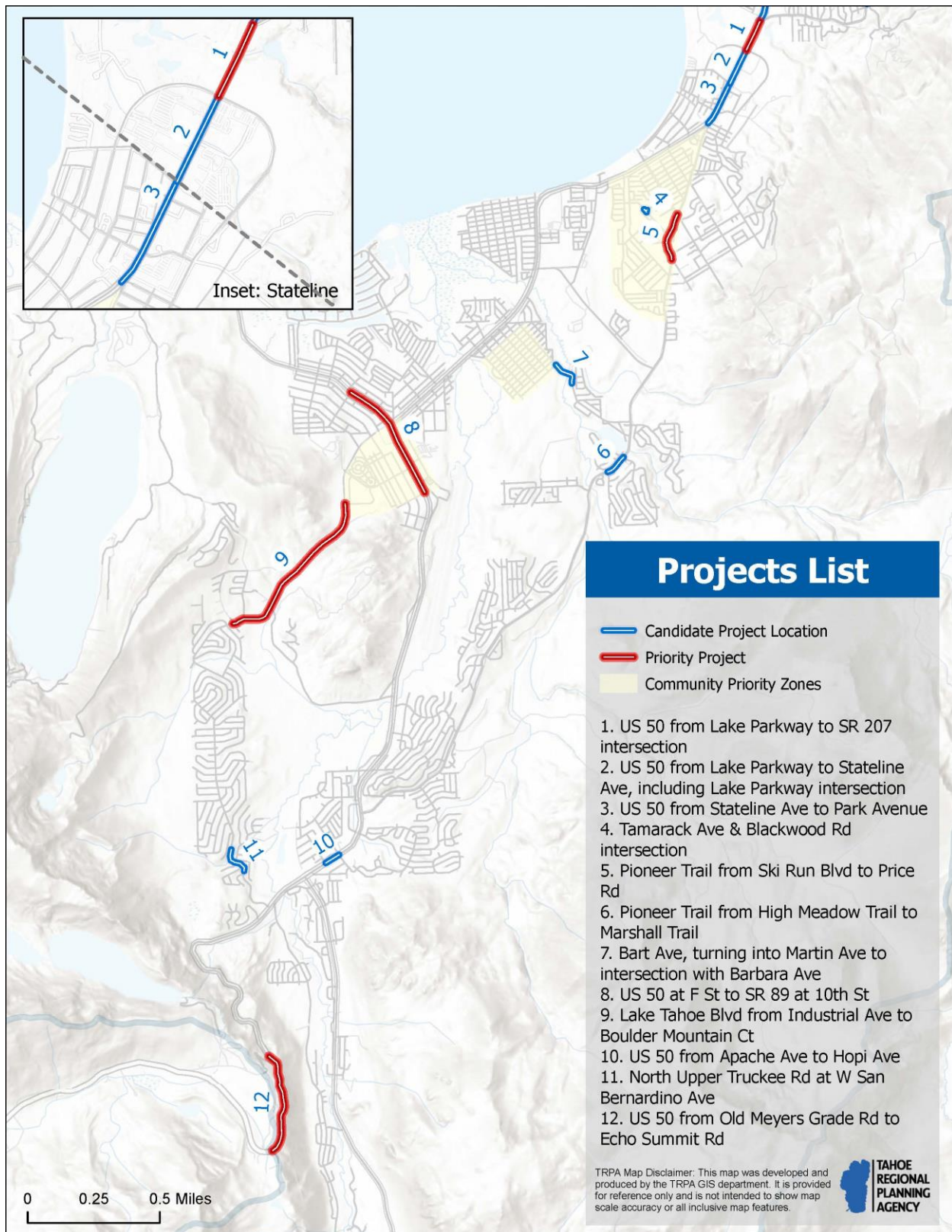


Figure 6.1: South Shore Projects List

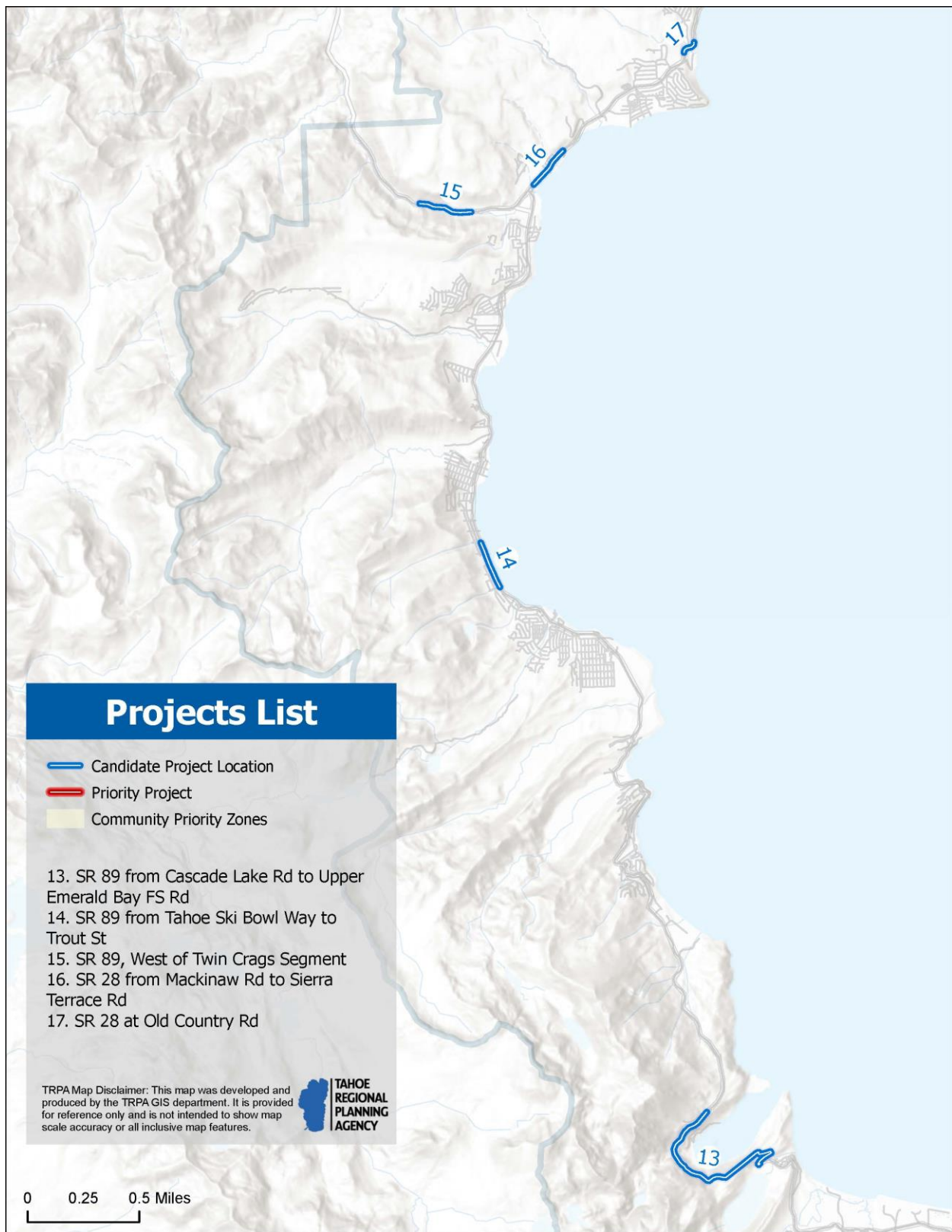


Figure 6.2: West Shore Projects List



Figure 6.3: North Shore Projects List



Figure 6.4: East Shore Projects List

Priority Projects

The Top 8 Priority Project List includes projects that met two or more criteria (High Injury Network, Equity, and Level of Traffic Stress) and are regionally significant. We discussed projects with the implementing jurisdictions and also considered the feasibility to implement in the near to mid-future and funding needs. The following section outlines potential safety measures and costs for priority projects as guides, subject to adjustments based on further studies, planning, public input, and unforeseen factors during implementation. Projects in the Top 8 may undergo in-depth studies, planning, environmental analysis, and public engagement overseen by implementing agencies. Anticipated cost estimate adjustments before implementation are expected due to various factors, including outcomes of additional planning and studies, design modifications based on public input, unforeseen acquisitions of right of way or easements, and adjustments for inflation.

Top 8 Projects:

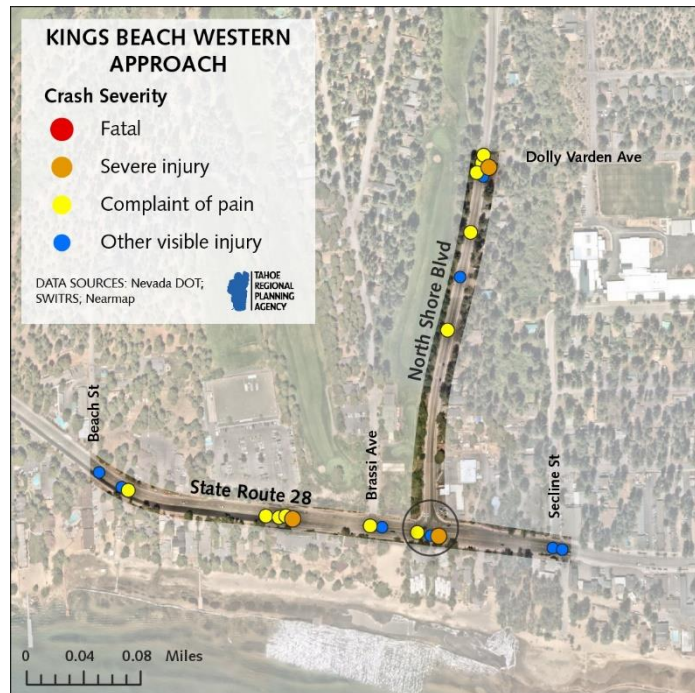
1. Kings Beach Western Approach: SR-28/N Lake Blvd from Beach St to Secline St including SR 28 & SR 267 intersection and SR 267 to Dolly Varden Ave
2. US 50 at F Street to SR 89 at 10th St, including the US 50 & SR 89 intersection
3. US 50 from Old Meyers Grade Rd to Echo Summit Rd
4. US 50 from Lakeview Drive to Church St
5. US 50 from Lake Parkway to SR 207 intersection
6. Lake Tahoe Blvd Roadway Reconfiguration: Lake Tahoe Blvd Rd from Industrial Ave to Boulder Mountain Ct
7. SR 28 from Northwood Blvd to Northwood Blvd
8. Pioneer Trail from Ski Run Blvd to Price Rd



Kings Beach Western Approach: SR-28/N Lake Blvd from Beach St to Secline St, SR 28 & SR 267 intersection, and SR 267 to Dolly Varden Ave

Crash History (2013 to 2021)

- 21 Total injury crashes along 0.35-mile segment of N Lake Blvd and 0.26-mile segment of SR 267
- **Severity of Injuries:** Three serious, 11 complaint of pain, seven other visible injury
- **Modes Involved:** Ten motorcycle-involved, one bicycle-involved, one pedestrian-involved, nine vehicle only
- **Crash Types:** Eight rear-end, five angle, four hit object, one head-on, one vehicle/pedestrian, one sideswipe, and one overturned



Potential Safety Countermeasures

Intersection Treatments:

- Roundabout
- High visibility crosswalks
- Pedestrian scale lighting
- ADA crosswalks
- Leading pedestrian interval
- Pedestrian medians

Segment Treatments:

- Sidewalk along SR 267 from SR 28 to Dolly Varden Ave
- Class 2 Bicycle lanes
- Roadway reconfiguration along SR 28 from Beach St to SR 267

Approximate Cost

\$14,000,000

US 50 at F Street to SR 89 at 10th Street, including US 50/SR 89 intersection

Crash History (2013 to 2021)

- 19 Total injury crashes along 1.23-mile segment
- **Severity of Injuries:** Five serious, nine complaint of pain, four other visible injury
- **Modes Involved:** Eleven vehicle-involved only, four bicycle-involved, three motorcycle-involved, and one pedestrian-involved
- **Crash Types:** Eight angle, three hit object, three rear-end, three head-on, one vehicle/pedestrian, one unknown
- **Other trends:** Two pedestrians and one bicyclist injured in crashes that occurred in the dark



Safety Countermeasures

Intersection Treatments:

- Reconfiguration of Y intersection (following an Intersection Control Evaluation)
- Pedestrian countdown signals at Y intersection
- Leading pedestrian intervals at Y intersection
- Pedestrian crossing B Street and US 50
- Pedestrian Hybrid Beacon (PHB/HAWK)
- Intersection pavement markings
- Pedestrian crossing at 10th street and SR 89
- Intersection pavement markings

Segment Treatments:

- Roadway reconfiguration from F St to B St (0.5 mile)
- Class 4 bicycle lanes with green paint from F St to 13th St. (1.6 miles)
- Pedestrian scale lighting

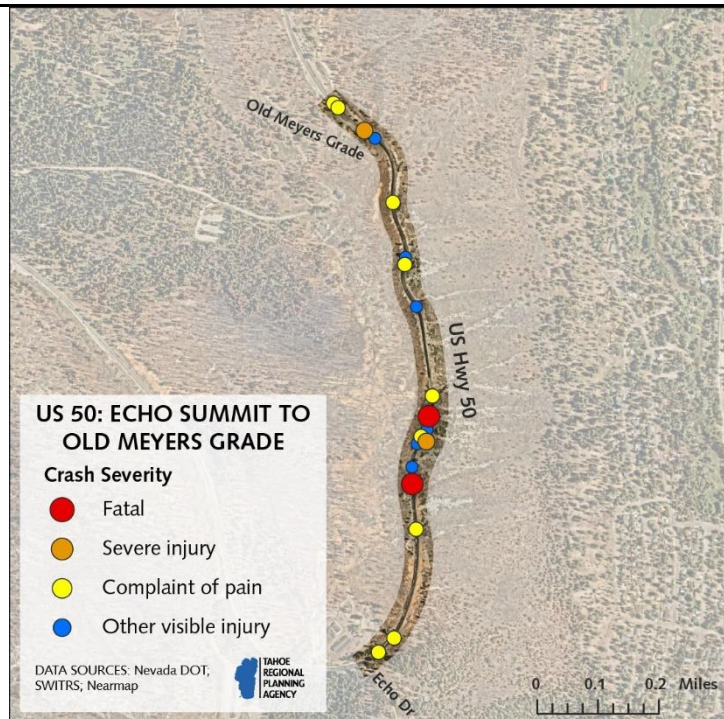
Approximate Cost

\$30,000,000

US-50, Old Meyers Grade Rd to Echo Summit Rd

Crash History (2013 to 2021)

- 17 Total injury crashes along 1.0-mile segment
- **Severity of Injuries:** Two fatal, two serious, seven complaint of pain, six other visible injury
- **Modes Involved:** Thirteen vehicle only, three motorcycle-involved, one bicycle-involved
- **Crash Types:** Seven hit object, seven head-on, one rear-end, one overturned, one angle



Potential Safety Countermeasures

Segment Treatments:

- Curve Advance Warning Signs
- Dynamic Speed Warning Signs
- New signs with fluorescent sheeting
- Chevron signs on horizontal curves
- Delineators, reflectors
- Centerline rumble strips

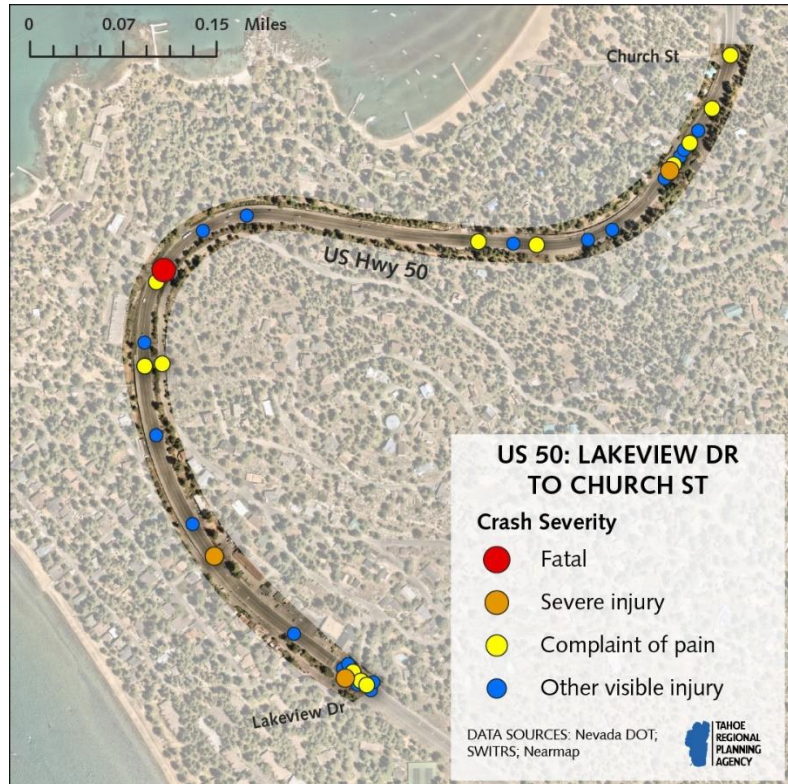
Approximate Cost

\$900,000

US 50, Lakeview Drive around Presbyterian Curve to Church St

Crash History (2013 to 2021)

- 38 total injury crashes along 0.94-mile segment
- **Severity of injuries:** One fatal, three severe, fourteen complaint of pain, twenty other visible injury
- **Modes involved:** Thirty-four vehicle-involved only crashes, two motorcycle-involved, one bicycle-involved, one pedestrian-involved
- **Crash Types:** Twelve angle, ten non-collision, five head-on, six rear-end, four sideswipe, one other
- **Other trends:** Crashes associated with high speeds and turning



Potential Safety Countermeasures

Segment Treatments:

- Roadway Reconfiguration (appx. One mile) with turn lanes
- Install edge-lit speed limit signs
- Speed limit pavement markings
- Dynamic speed feedback signs
- Adaptive signal timing
- Improve RRFB at Lakeview Dr

Approximate Cost*

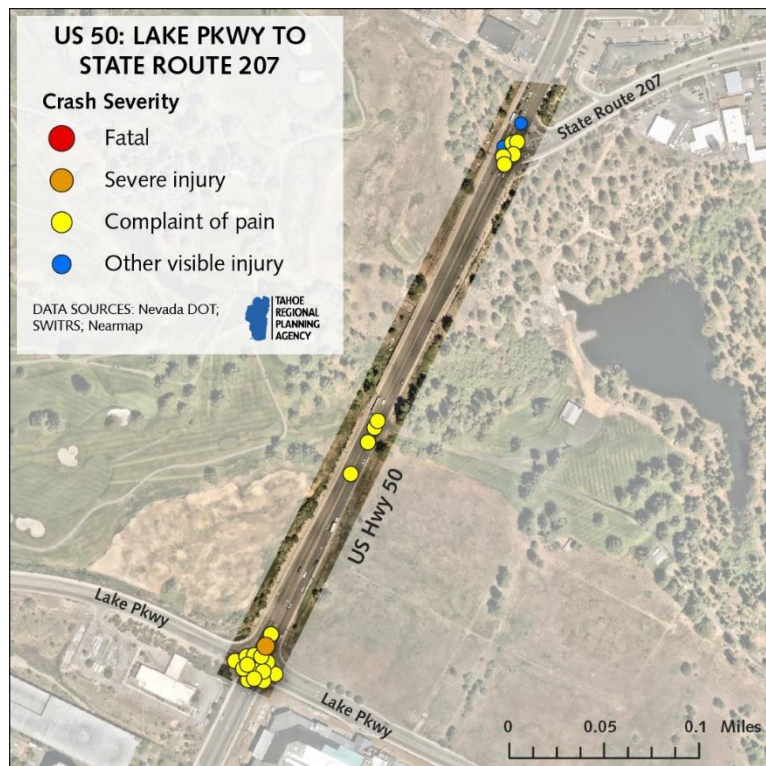
\$2,000,000

*Does not include East Shore Trail or off highway parking at Zephyr Cove, which are longer term improvements the US 50 East Corridor Management Plan identified.

US 50 from Lake Parkway to SR 207 Intersection

Crash History (2013 to 2021)

- 31 total injury crashes along 0.33-mile segment
- **Severity of injuries:** One serious, twenty-five complaint of pain, five other visible injury
- **Modes involved:** Twenty-six vehicle only, two motorcycle-involved, one pedestrian-involved, two bicycle-involved
- **Crash Types:** Thirteen rear-end crashes, nine angle broad-side, four sideswipe, three non-collision, one head-on, one unreported



Potential Safety Countermeasures

Segment Treatments:

- Sidewalk with curb and gutter and ADA ramps on East side
- Class 1 path on West side, connecting to 4H road/Laura Drive

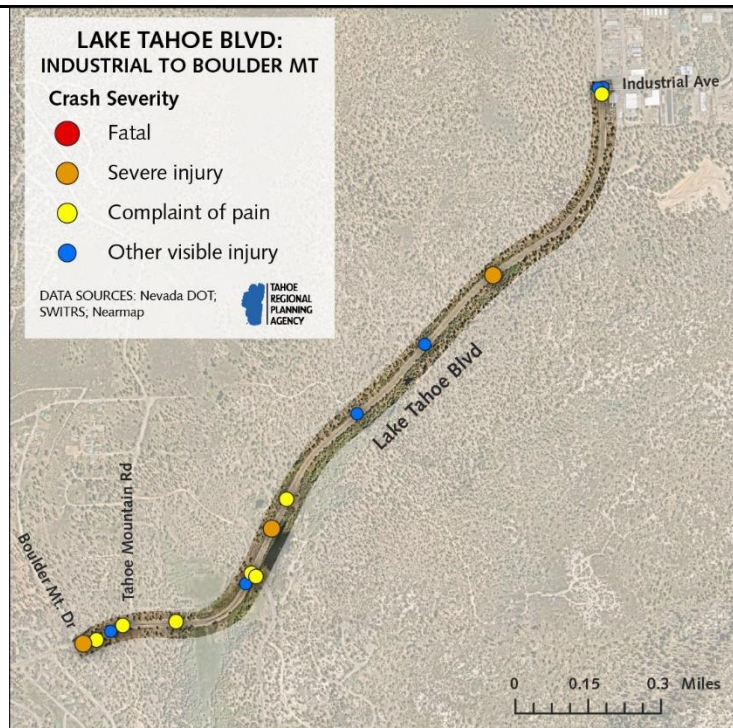
Approximate Cost

\$5,000,000

Lake Tahoe Blvd from Industrial Ave to Boulder Mountain Ct

Crash History (2013 to 2021)

- 16 Total injury crashes along 1.7-mile segment
- **Severity of Injuries:** Three severe injury, seven complaint of pain, six other visible injury
- **Modes Involved:** Two motorcycle-involved, 14 vehicle only
- **Crash Types:** Nine hit-object, two rear-end, two angle, three overturned
- **Other trends:** seven crashes that involved a party that had been drinking



Potential Safety Countermeasures

Intersection Treatments:

-Dedicated left- and right-hand turn lanes at Industrial Ave & Lake Tahoe Blvd

Segment Treatments:

-Roadway reconfiguration from Industrial to Sawmill: reduce to one lane and add Class 2 bicycle lanes

-Edge line rumble strips

-Remove, relocate, or protect fixed objects

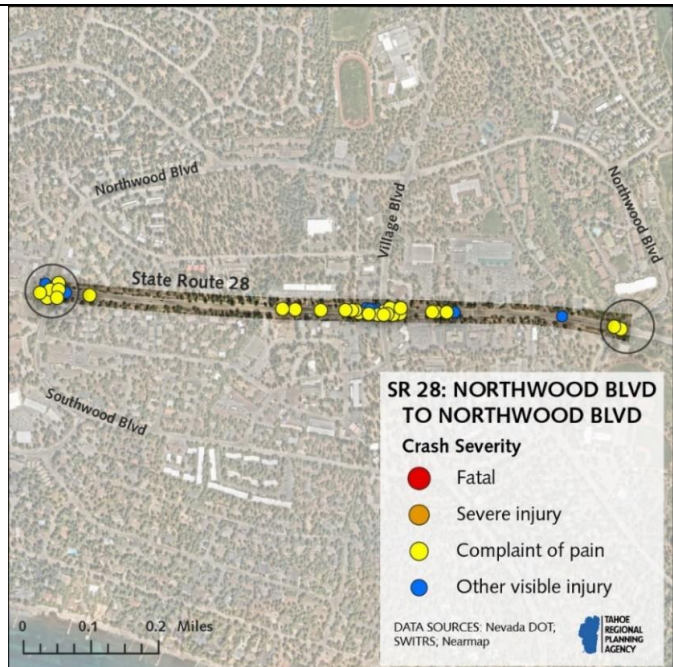
Approximate Cost

\$2,500,000

SR28 from Northwood Blvd to Northwood Blvd

Crash History (2013 to 2021)

- 39 total fatal or injury crashes along 0.84-mile segment
- **Severity:** One serious, twenty-seven complaint of pain, eleven other visible injury
- **Modes Involved:** Thirty-six vehicle-involved only, one motorcycle-involved, one bicycle-involved, one pedestrian-involved
- **Crash Types:** Sixteen angle, sixteen rear-end, three sideswipe, three non-collision, 1 unreported



Potential Safety Countermeasures

Intersection Treatments:

- Convert SR 28 & Southwood Blvd/Northwood Blvd (East) to traffic signal or roundabout (following an Intersection Control Evaluation)
- Add bus pull-out at SR 28 & Southwood/Northwood Blvd (East) and relocate bus stop to East side to reduce crossings
- Enhance crosswalks
- Bulb-outs
- Leading pedestrian intervals at stoplights

Segment Treatments:

- Class 2 bicycle lanes on North side of SR 28

*Long-term: consolidate driveways, square up intersections with skewed angles

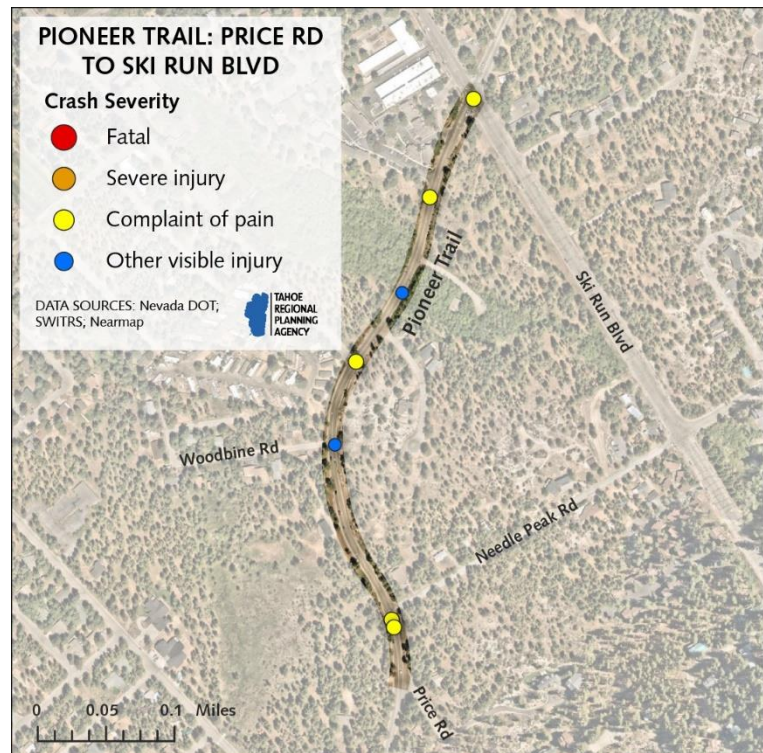
Approximate Cost

\$750,000 with signal, \$5-10M with roundabout
*Cost does not include potential long-term recommendations

Pioneer Trail from Ski Run Blvd to Price Rd

Crash History (2013 to 2021)

- 7 Total Injury Crashes along 0.47-mile Segment
- **Severity:** Five complaint of pain, two other visible injury
- **Modes Involved:** All motor vehicle only crashes
- **Crash types:** Two rear-end, one head-on, one sideswipe, and three hit object crashes
- **Other trends:** Three crashes in snowy/icy conditions, two of which occurred at the curve at Needle Peak Rd



Potential Safety Countermeasures

Segment Treatments:

- Dynamic speed warning signs (2)
- Chevron signs on curve
- Remove, relocate or protect fixed objects adjacent to road
- Ensure class 2 bicycle lanes meet required 4ft width
- Drainage improvements to reduce ice on roadway

Approximate Cost

\$250,000

Equity Impacts of Priority Projects

To implement the policies endorsed in the Transportation Equity Study and ensure equity is a primary consideration of the Vision Zero Strategy, the top eight priority projects each underwent an additional equity assessment. Each priority project was evaluated against the potential equity benefits identified in Chapter 4:

- **Reducing disparities**
- **Encouraging active transportation**
- **Fostering social inclusion**
- **Enhancing economic opportunities**
- **Reducing conflicts with law enforcement**
- **Building public support**

Kings Beach Western Approach: SR-28/N Lake Blvd from Beach St to Secline St including SR 28 & SR 267 intersection

- **Reducing disparities**
 - Low-income communities and minority populations are disproportionately affected by traffic crashes. Kings Beach is a Community Priority Zone with a concentration of zero vehicle households, high disability density, and high poverty density. Planned intersection improvements are intended to provide safer transportation options for all modes, which will reduce these crash disparities.
- **Encouraging active transportation**
 - Includes active transportation improvements, including sidewalks and class 2 bicycle lanes along the segment. The constructed roundabout will have high visibility crosswalks and pedestrian medians to provide safer crossings.
- **Fostering social inclusion**
 - Addition of ADA crosswalks and ramps to provide accessible transportation to individuals with disabilities.
- **Enhancing economic opportunities**
 - The project will provide a continuous Complete Street corridor throughout the town center, from the downtown core to the west side of the community, providing safer access to jobs, grocery stores, and medical clinics.
- **Reducing conflicts with law enforcement**
 - Roadway reconfigurations provide traffic calming, reduce vehicle speeds and reduce crash rates by approximately 30 percent according to Caltrans. The roundabout will also provide traffic calming, reduce vehicle speeds, and reduce conflict points. These engineering measures are likely to reduce necessary interventions by law enforcement.

US 50 from F Street to SR 89 at 10th St, including SR 89/US 50 Intersection

- **Reducing disparities**
 - Low-income communities and minority populations are disproportionately affected by traffic crashes and fatalities. The proposed countermeasures will provide safer transportation through targeted intersection improvements and roadway reconfigurations, directly benefiting the Tahoe Verde Community Priority Zone, which

has a concentration of zero vehicle households, high disability density, and high poverty density.

- **Encouraging active transportation**
 - Proposed countermeasures aim to provide safer active transportation, including pedestrian countdown signals, leading pedestrian intervals, new pedestrian crossings, pedestrian scale lighting, and class 4 bicycle lanes.
- **Fostering social inclusion**
 - All crossings and intersections will be ADA compliant, including audible and tactile crossing signals, to provide safe transportation for all.
- **Enhancing economic opportunities**
 - This project is located in the heart of the South Y town center, which includes grocery stores, a hospital, pharmacies, restaurants, and retail stores. Proposed improvements will provide safer access to jobs, essential services, and healthcare.
- **Reducing conflicts with law enforcement**
 - A roadway reconfiguration from F St to B St will be considered, which has the potential to reduce potential conflicts with law enforcement through traffic calming and reduced crash rates.
- **Building public support**
 - This project comes on the heels of a recent proposal from Caltrans to increase the speed limit along this segment. The community came out in numbers against this proposal, advocating for slower speeds and safer streets.

US-50, Old Meyers Grade Rd to Echo Summit Rd

- **Enhancing economic opportunities**
 - The Transportation Equity Study highlighted how the limited availability of Medicare providers in the Tahoe Basin greatly impacts residents, especially those who depend on regular care such as seniors and people with disabilities. MediCal providers for vision and dental are located in Placerville and additional Medicare providers are located in Sacramento. US 50 serves as a key connection from South Lake Tahoe to Placerville, Sacramento, and beyond. Improving safety in this corridor provides safer access to healthcare and other essential services out of the Basin.
- **Reducing conflicts with law enforcement**
 - The focus on safer road infrastructure including dynamic speed warning signs, curve advance warning signs, and chevron signs seeks to slow vehicles down and reduce the need for traffic stops.

US 50, Lakeview Drive around Presbyterian Curve to Church St

- **Enhancing economic opportunities**
 - The US 50 East Corridor is the primary link between South Lake Tahoe and the Carson Valley. As affordable housing opportunities dwindle in South Lake Tahoe, workers forced to move to the valley use this corridor to commute to jobs on the South Shore. Additionally, several affordable grocery and healthcare services are located in Carson City or Minden and Gardnerville which necessitates travel along the Hwy 50 East

Corridor for South Lake Tahoe residents trying to access those services. Improving safety along this segment, which has a high rate of injury crashes, will improve essential access between South Lake Tahoe and the Carson Valley.

- **Reducing conflicts with law enforcement and building public support**
 - Severe and fatal crashes require significant response from law enforcement and can require lengthy traffic delays and even road closures to address injuries, report the incident, and clean up the scene. In 2020, [a fatal crash along this segment](#), prompted a complete road closure for several hours. Prioritizing safety at this segment can prevent traffic delays, improve overall travel times, and reduce the need for law enforcement intervention, which are needs cited throughout the [US 50 East Corridor Management Plan](#) process.

US 50 from Lake Parkway to SR 207 Intersection

- **Encouraging active transportation**
 - The proposed sidewalk and class 1 path seek to provide safe active transportation and close a significant gap in the network and the Tahoe Trail around the Lake.
- **Fostering social inclusion**
 - The sidewalk and path will be ADA compliant to provide accessibility.
- **Enhancing economic opportunities**
 - This segment serves as a connection between two town centers: the Nevada South Stateline Resort Area and the Kingsbury Commercial Area. There are medical facilities in the Kingsbury Commercial Area, including an urgent care, and plans for a new hospital to be built nearby. The Stateline Resort Area includes the new Tahoe Event Center, hotels and casinos, and the Heavenly Gondola, which are several of the largest employers in South Lake Tahoe. Roadway, bicycle, and pedestrian improvements along this segment will provide safer access to entertainment, jobs, healthcare, and other essential services.

Lake Tahoe Blvd from Industrial Ave to Boulder Mountain Court

- **Encouraging active transportation**
 - Adds class 2 bicycle lanes to encourage travel by bicycle, particularly important for individuals who may not have access to private vehicles, or for people travelling by bicycle in the winter when the adjacent bike path is not plowed.
- **Reduces conflicts with law enforcement**
 - Roadway reconfigurations provide traffic calming, reducing crash rates by approximately 30 percent. Through these engineering measures, contact with law enforcement may be reduced.

SR 28 from Northwood Blvd to Northwood Blvd

- **Encouraging active transportation**
 - Proposes improvements to provide safer crossings for pedestrians.
- **Enhancing economic opportunities**
 - SR 28 from Northwood Blvd to Northwood Blvd lies entirely within the Incline Village town center and there are several driveways throughout that connect to grocery stores,

local businesses, restaurants, and retail stores. The proposed improvements will enhance mobility throughout the corridor and increase safety for all users.

- **Reduces conflicts with law enforcement**
 - Improving safety at intersections and crossings within the Incline Village town center will increase roadway safety for all and may free up limited resources to enforce other areas of Incline Village and Crystal Bay.

Pioneer Trail from Ski Run Blvd to Price Rd

- **Reducing disparities**
 - Low-income communities and minority populations are disproportionately affected by traffic crashes and fatalities. The proposed countermeasures will provide safer transportation, directly benefiting the Bijou Community Priority Zone, which has a concentration of zero vehicle households, high disability density, and high poverty density.
- **Encouraging active transportation**
 - Proposed bicycle lanes and auto speed reduction strategies will improve active transportation connectivity and safety along Pioneer Trail.



7.0 NEXT STEPS

This Vision Zero Strategy is meant to be a living document that continues long after endorsement by the TRPA Governing Board. TRPA and its regional partners will work towards improving safety for all road users, with a focus on fatal and serious injuries. TRPA will work to implement the identified strategies in Chapter 5.0 and consider adoption of the proposed policy changes in the future 2025 Regional Transportation Plan. We will work with local and state agencies to fund and implement the candidate projects identified in Chapter 6.0, with an emphasis on the top 8 priority projects, and utilize the Countermeasures Toolbox (Appendix A) for safer designed streets. The implementation of safety projects will be discussed at Tahoe Transportation Implementation Collaborative (TTIC) meetings. We will continue to work together to improve the quality of and access to crash data across the Tahoe Region and update crash data annually to the [Crash Data Dashboard](#). TRPA, with help from stakeholders on the Transportation Performance Technical Advisory Committee (TPTAC), will continue to evaluate our progress towards meeting our goal of Vision Zero. We will be analyzing safety metrics through annual federal performance measure reporting and in the Transportation Performance Report, which will be published every two years. We will also provide biennial updates to the Governing Board, with an opportunity for public input.

Appendices

Appendix A – Vision Zero Countermeasures Toolbox

Appendix B – Funding Opportunities

Appendix C – Draft Vision Zero Resolution

Appendix D – Community Outreach Survey

APPENDIX A: LAKE TAHOE REGION COUNTERMEASURE TOOLBOX

A photograph of a snowy road with a crosswalk. In the background, there are tall evergreen trees and a small building. On the right side of the road, there are two yellow traffic signs: a diamond-shaped sign with a black silhouette of a person walking, and a rectangular sign with a black arrow pointing down and to the left. The road is covered in snow, and there are snowbanks on either side of the crosswalk.

LAKE TAHOE REGION VISION ZERO STRATEGY SAFETY COUNTERMEASURES TOOLBOX

Originally Prepared in 2019 By
Kittelson & Associates, Inc.
Updated in 2023 By
Tahoe Regional Planning Agency



TABLE OF CONTENTS

TREATMENT SUBGROUP	COUNTERMEASURE	CRASH REDUCTION POTENTIAL	CA HSIP ELIGIBILITY	PAGE
ROADWAY SEGMENTS - RURAL OR LIMITED DEVELOPMENT				1
Signs	Dynamic Speed Warning Signs on Turn	30%	100%	2
Signs	Oversized Warning/Regulatory Signs	15%	100%	3
Signs	Chevron Signs on Horizontal Curves	40%	100%	4
Signs	Curve Advance Warning Signs	25%	100%	5
Signs	Dynamic Message Signs	16%	0%	6
Pavement Treatment	Improve Pavement Friction	55%	100%	7
Pavement Treatment	TRPA Approved Centerline Rumble Strips/Stripes	20%	100%	8
Pavement Treatment	TRPA Approved Edgeline Rumble Strips/Stripes	15%	100%	9
Edge Treatment	Delineators, Reflectors, or Object Markers	15%	100%	10
Edge Treatment	Remove, Relocate, or Protect Fixed Objects Adjacent to Road	35%	90%	11
Speed Management	Variable Speed Limits	34%	0%	12
Other	Truck Climbing Lane	43%	0%	13
Other	Acceleration/Deceleration Lanes	25%	90%	14
INTERSECTIONS - ANY LAND USE CONDITION				15
All Location Types	Intersection Lighting	40%	100%	16
All intersections	Curb Extensions/Bulb-outs	N/A	90%	17
Signalized	Pedestrian Countdown Signal Heads	25%	100%	18
Signalized	Signal Timing Adjustments	15%	50%	19

TREATMENT SUBGROUP	COUNTERMEASURE	CRASH REDUCTION POTENTIAL	CA HSIP ELIGIBILITY	PAGE
Signalized	Advance Dilemma Zone Detection	40%	100%	20
Signalized	Adaptive Signal Timing	17%	0%	21
Signalized	Leading Pedestrian Interval at Traffic Signal	60%	100%	22
Signalized	Exclusive Pedestrian Phasing	40%	100%	23
Signalized	Advance Stop Bar Before Crosswalk (Bike Box)	15%	100%	24
Signalized	Backplates with Retroreflective Borders	15%	100%	25
Signalized	Protected Intersections	N/A	0%	26
Unsignalized	Intersection Pavement Markings	25%	100%	27
Unsignalized	Roundabout	12-78%	100%	28
ROADWAY SEGMENTS - MIXED LAND USES, MULTIMODAL				29
Access Management	Raised Median	25%	90%	30
Access Management	Directional Median Openings	50%	90%	31
Access Management	Driveway Access Management	5-31%	0%	32
Pedestrian Crossing	Raised Medians/Refuge Islands	45%	90%	33
Pedestrian Crossing	Enhanced Pedestrian Crossing at Uncontrolled Locations	35%	100%	34
Pedestrian Crossing	Pedestrian Hybrid Beacon (PHB or HAWK)	55%	100%	35
Pedestrian Crossing	Pedestrian Underpass	N/A	0%	36
Pedestrian Crossing	Pedestrian Overpass Bridge	N/A	0%	37
Roadway Configuration	Sidewalk	80%	90%	38
Roadway Configuration	Shared Use Path (Class 1)	N/A	90%	39
Roadway Configuration	Bicycle Lanes - Traditional (Class 2), Buffered (Class 2B)	35%	90%	40
Roadway Configuration	Bicycle Routes (Class 3)	N/A	0%	41
Roadway Configuration	Separated Bicycle Lanes or Cycle Tracks (Class 4)	45%	90%	42
Roadway Configuration	Roadway Reconfiguration	30%	90%	43
Transit/Microtransit	Bus Pull-out	N/A	0%	44
Transit/Microtransit	Bus Boarding Islands	N/A	0%	45
Signs	Gateway Sign	N/A	0%	46

GUIDE TO COUNTERMEASURES TOOLBOX

INTRODUCTION

Each page starts with the name of the treatment, a photo of typical implementation of the treatment, and the location type where it is applicable: *unsignalized intersection*, *signalized intersection*, or *roadway segment*.

DESCRIPTION AND PLACEMENT DETAILS

This section provides a brief description of the treatment, including:

- How the treatment may improve safety performance.
- Specific conditions in the Tahoe Region that may make the treatment a good fit.
- Context considerations for implementing the treatment, such as traffic volume or speed limit.

SIGNS

DYNAMIC SPEED WARNING SIGNS

Dynamic speed warning signs provide a direct alert to drivers if they are exceeding the posted advisory speed when approaching a turn or a corridor with lower speeds.

WHY WAS THIS CHOSEN FOR TAHOE?

- Presence of multiple locations where state facilities transition from regional connections to mixed land use corridors. Unsafe speeds are a common factor in crashes on state facilities in the Tahoe Region.
- Single-vehicle crashes are common at the outside edge of curved roads in the Tahoe Region.
- Dynamic signs respond to individual driver behavior to provide a targeted warning for unsafe speeds.

PLACEMENT & DESIGN CONSIDERATIONS

- Consider combining with the following treatments: chevron signs or curve advance warning signs.
- Use posts designed to break away or otherwise minimize damage if an errant motorist strikes them.
- Signs should be located to warn drivers prior to a curve or entry to a lower-speed roadway section.

CRASHES

APPLICABLE TYPES
ALL

30%
POTENTIAL
CRASH
REDUCTION*

APPROXIMATE COST
\$7,500
PER SIGN**

EXPECTED DESIGN LIFE
10
YEARS

IMPLEMENTATION TIME FRAME

● ● ● SHORT

ADDITIONAL INFO

- [Caltrans Local Roadway Safety Manual](#)
- [FHWA Proven Safety Countermeasures](#)

Source: Local Roadway Safety Manual, Version 1.5, April 2020.

**Cost estimate is from 2019 and will need to be evaluated on project specific basis.

TRPA Lake Tahoe Region Rapid Assessment and Response to Safety Toolbox - Roadway Segments - Rural Limited Development

CRASH DETAILS

This section reports the treatment's impacts to expected crashes.

Types addressed: A classification of the types of crashes impacted.

Potential Crash Reduction: Potential effectiveness of the treatment in reducing crashes, expressed as a percentage of historical crashes observed at a location. The expected reduction is based on the Caltrans *Local Roadway Safety Manual*, *FHWA Proven Safety Countermeasures*, or research found on the Federal Highway *Crash Modification Factors (CMF) Clearinghouse*.

COST & DESIGN LIFE

The cost are estimates for a 'standard' version of the treatment. There will be additional construction costs beyond the estimate. The expected design life is based on the Caltrans *Local Roadway Safety Manual*, except where noted otherwise.

ADDITIONAL INFO

Provides resources that support and provide more information on the countermeasure. The California Local Roadway Safety Manual also includes CA HSIP funding eligibility. See the table of contents for all CA HSIP eligibilities.

IMPLEMENTATION TIME FRAME

Indicates approximate timeframe to implement. Short is 0 to 2 years, medium is 2 to 5 years, and long is 5+ years.

A dark gray trapezoidal graphic element with a diagonal cut on the left side, containing white text.

01 **ROADWAY SEGMENTS**

Rural or Limited Development

DYNAMIC SPEED WARNING SIGNS

Dynamic speed warning signs provide a direct alert to drivers if they are exceeding the posted advisory speed when approaching a turn or a corridor with lower speeds.

WHY WAS THIS CHOSEN FOR TAHOE?

- Presence of multiple locations where state facilities transition from regional connections to mixed land use corridors. Unsafe speeds are a common factor in crashes on state facilities in the Tahoe Region.
- Single-vehicle crashes are common at the outside edge of curved roads in the Tahoe Region.
- Dynamic signs respond to individual driver behavior to provide a targeted warning for unsafe speeds.

PLACEMENT & DESIGN CONSIDERATIONS

- Consider combining with the following treatments: chevron signs or curve advance warning signs.
- Use posts designed to break away or otherwise minimize damage if an errant motorist strikes them.
- Signs should be located to warn drivers prior to a curve or entry to a lower-speed roadway section.



Photo: Kittelson & Associates, Inc.

CRASHES

APPLICABLE TYPES

ALL



POTENTIAL
CRASH
REDUCTION*

APPROXIMATE COST

\$40K

PER SIGN**

EXPECTED DESIGN LIFE

10
YEARS

IMPLEMENTATION TIME FRAME



SHORT

ADDITIONAL INFO

- [Caltrans Local Roadway Safety Manual](#)
- [FHWA Proven Safety Countermeasures](#)

* Caltrans, "Local Roadway Safety Manual," Version 1.5, April 2020.

**US Dept. of Transportation, "Use Case: Curve Speed Warning Benefit-Cost Analysis."

SIGNS

OVERSIZED WARNING/REGULATORY SIGNS

Large warning/regulatory signs improve visibility for drivers in advance of a stop or regulatory signs.

WHY WAS THIS CHOSEN FOR TAHOE?

- Stop-controlled intersections of highways and minor streets are a risk factor in crashes in the Tahoe Region.
- Large signs can help to improve driver awareness of approaching intersections or other conflict zones that may be hard to see or out of sight due to roadway curvature.

PLACEMENT & DESIGN CONSIDERATIONS

- Signs must be within approaching drivers' line of sight.
- Plans should consider the presence and placement of other existing signs and look for opportunities to reasonably consolidate or remove unnecessary signs to avoid sign clutter.



Photo: Kittelson & Associates, Inc.

CRASHES

APPLICABLE TYPES

ALL



POTENTIAL
CRASH
REDUCTION*

APPROXIMATE COST

\$600

PER SIGN

EXPECTED DESIGN LIFE

10
YEARS

IMPLEMENTATION TIME FRAME



SHORT

ADDITIONAL INFO

- [Caltrans Local Roadway Safety Manual](#)
- [FHWA Proven Safety Countermeasures](#)

* Caltrans, "Local Roadway Safety Manual," Version 1.5, April 2020.

SIGNS

CHEVRON SIGNS ON HORIZONTAL CURVES

Chevron signs provide a visual cue and guidance to drivers navigating a curve.

WHY WAS THIS CHOSEN FOR TAHOE?

- Unsafe speeds and improper turning are associated with fatal and severe crashes in the Tahoe Region.
- Single-vehicle crashes are common at the outside edge of curved roads in the Tahoe Region.
- Chevron signs assist in managing speed through a curve by providing a clear visual cues regarding the degree of the curve as motorists approach and drive through the curve.

PLACEMENT & DESIGN CONSIDERATIONS

- Use posts designed to break away or otherwise minimize damage if an errant motorist strikes them.
- Consider combining with the following treatments: curve advance warning signs or dynamic speed feedback signs.



Photo: Kittelson & Associates, Inc.

CRASHES

APPLICABLE TYPES

**RUN-OFF
ROAD, ALL**

40% POTENTIAL
CRASH
REDUCTION*

APPROXIMATE COST

\$600

PER SIGN

EXPECTED DESIGN LIFE

10
YEARS

IMPLEMENTATION TIME FRAME

● ○ ○ SHORT

ADDITIONAL INFO

- [Caltrans Local Roadway Safety Plan](#)
- [FHWA Proven Safety Countermeasures](#)

* Caltrans, "Local Roadway Safety Manual," Version 1.5, April 2020.

SIGNS

CURVE ADVANCE WARNING SIGNS

Curve advance warning signs provide a visual cue and guidance to drivers entering a curve.

WHY WAS THIS CHOSEN FOR TAHOE?

- Unsafe speeds and improper turning are associated with fatal and severe crashes in the Tahoe Region.
- Curve advance warning signs assist in managing speed through curves by alerting drivers and suggesting lower speeds.
- Single-vehicle crashes are common at the outside edge of curved roads in the Tahoe Region.

PLACEMENT & DESIGN CONSIDERATIONS

- Use posts designed to break away or otherwise minimize damage if an errant motorist strikes them.
- Consider combining with the following treatments, chevron signs or dynamic speed feedback signs.



Photo: Kittelson & Associates, Inc.

CRASHES

APPLICABLE TYPES

**RUN-OFF
ROAD, ALL**

25%*
↓
POTENTIAL
CRASH
REDUCTION

APPROXIMATE COST

\$600
PER SIGN**

EXPECTED DESIGN LIFE

10
YEARS

IMPLEMENTATION TIME FRAME

● ○ ○ SHORT

ADDITIONAL INFO

- [Caltrans Local Roadway Safety Plan](#)
- [FHWA Proven Safety Countermeasures](#)

* Caltrans, "Local Roadway Safety Manual," Version 1.5, April 2020.

** 30% crash reduction potential if flashing beacon is included.

** \$9,000 if flashing beacon is included.

SIGNS

DYNAMIC MESSAGE SIGNS

Dynamic Message Signs (DMS) are electronic signs on the highway that provide drivers with real-time traffic alerts.

WHY WAS THIS CHOSEN FOR TAHOE?

- Queue warning signs reduce collisions by alerting drivers to slowed or stopped traffic ahead.
- Helps protect construction workers, who are vulnerable road users per FHWA VRU Safety Assessment Guidance.

PLACEMENT & DESIGN CONSIDERATIONS

- Appropriate where queues occur frequently, curves, steep grades, or poor visibility, where drivers might have limited reaction time to see and respond to a queue ahead.
- Provide real-time information for congestion, construction, maintenance, special events, parking availability, or evacuation.
- Signs may be temporary or permanent. Consider frequency of placement with scenic implications.
- Based upon the sophistication of the system and the specific needs, systems can operate automatically using real-time traffic detectors as a trigger, or manually controlled by an operator.



Photo: Houston System

CRASHES

APPLICABLE TYPES

**REAR-END,
WORK ZONES**



POTENTIAL
CRASH
REDUCTION*

APPROXIMATE COST

\$125K

PER SIGN**

EXPECTED DESIGN LIFE

15
YEARS

IMPLEMENTATION TIME FRAME



SHORT to
MEDIUM

ADDITIONAL INFO

- [Uses of and Nonstandard Syntax on Changeable Message Signs \(FHWA\)](#)

* Elvik, R. and Vaa, T., "Handbook of Road Safety Measures." Oxford, United Kingdom, Elsevier, (2004)

*Crash reduction potential statistic for queue warning signs specifically

**Cost estimate from FHWA; should be evaluated on project specific basis.

IMPROVE PAVEMENT FRICTION



Photo: Kittelson & Associates, Inc.

Improved pavement friction applications increase vehicle ability to remain on the roadway and can help reduce single-vehicle run off road crashes, particularly on curves.

WHY WAS THIS CHOSEN FOR TAHOE?

- Single-vehicle crashes are common at the outside edge of curved roads in the Tahoe Region.
- Improved pavement friction helps drivers remain in their travel lane on curves during inclement conditions.

PLACEMENT & DESIGN CONSIDERATIONS

- Potential sites include: horizontal curves, interchange ramps, intersection approaches, higher-speed signalized and stop-controlled intersections, steep downward grades, crosswalk approaches, and locations with a history of rear-end, failure to yield, wet-weather, or redlight-running crashes.
- Approximately 70% of wet pavement crashes can be prevented or minimized by improved pavement friction, according to studies by the National Transportation Safety Board and FHWA.

CRASHES

APPLICABLE TYPES

**WET, NIGHT,
ALL**



POTENTIAL
CRASH
REDUCTION*

APPROXIMATE COST

\$3

PER SQUARE FOOT

EXPECTED DESIGN LIFE

10
YEARS

IMPLEMENTATION TIME FRAME



SHORT

ADDITIONAL INFO

- [Caltrans Local Roadway Safety Plan](#)
- [FHWA Proven Safety Countermeasures](#)

**Caltrans, "Local Roadway Safety Manual," Version 1.5, April 2020.*

TRPA APPROVED CENTERLINE RUMBLE STRIPS/STRIPES



Photo: Kittelson & Associates, Inc.

Centerline rumble strips provide auditory and tactile feedback to drivers that their vehicles have left the travel lane. Pavement markings over the strips (called rumble stripes) enhance the markings in wet and dark conditions.

WHY WAS THIS CHOSEN FOR TAHOE?

- Head-on crashes are the largest contributor to fatal and severe injury crashes in the Tahoe Region.
- Undivided roadway alignments tend to create a higher risk for head-on crashes.

PLACEMENT & DESIGN CONSIDERATIONS

- Apply continuously along an identified corridor.
- This treatment should be installed consistent with TRPA Ordinance Chapter 68.7.4 on reducing transmission of roadway noise.
- Suited to highways and non-residential roadways with a low pedestrian and bicycle use.
- Only to be used on roadways without a two-way left-turn lane.

CRASHES

APPLICABLE TYPES

HEAD-ON, SIDE-SWIPE, ALL



20% POTENTIAL CRASH REDUCTION*

APPROXIMATE COST

\$12

PER LINEAR FOOT

EXPECTED DESIGN LIFE

10
YEARS

IMPLEMENTATION TIME FRAME



MEDIUM

ADDITIONAL INFO

- [Caltrans Local Roadway Safety Plan](#)
- [FHWA Proven Safety Countermeasures](#)

* Caltrans, "Local Roadway Safety Manual," Version 1.5, April 2020.
FHWA, "Rumble Strips and Rumble Stripes," February 1, 2017

TRPA APPROVED EDGELINE RUMBLE STRIPS/STRIPES



Photo: Kittelson & Associates, Inc.

Edgeline rumble strips provide auditory and tactile feedback to drivers that their vehicles are leaving the roadway. Pavement markings over the strips (called rumble stripes) enhance the markings in wet and dark conditions.

WHY WAS THIS CHOSEN FOR TAHOE?

- Single-vehicle crashes are common at the outside edge of curved roads in the Tahoe Region.
- Many roadways in the Tahoe Region lack recovery space; edgeline rumble strips would provide drivers with a warning before they leave the roadway.

PLACEMENT & DESIGN CONSIDERATIONS

- Appropriate where bicycle lanes are to full width per MUTCD standards so that rumble strips are not an impediment to bicyclists.
- This treatment should be installed consistent with TRPA Ordinance Chapter 68.7.4 on reducing transmission of roadway noise.
- Gaps in the rumble strips should be installed at locations where bicycles are likely to enter or exit the shoulder.

CRASHES

APPLICABLE TYPES

**RUN-OFF
ROAD**



POTENTIAL
CRASH
REDUCTION*

APPROXIMATE COST

\$12

PER LINEAR FOOT

EXPECTED DESIGN LIFE

10
YEARS

IMPLEMENTATION TIME FRAME



MEDIUM

ADDITIONAL INFO

- [Caltrans Local Roadway Safety Plan](#)
- [FHWA Proven Safety Countermeasures](#)

* Caltrans, "Local Roadway Safety Manual," Version 1.5, April 2020.

EDGE TREATMENT

DELINEATORS, REFLECTORS, OR OBJECT MARKERS

Delineators clarify the path of travel for vehicles through turns, and provide positive guidance to help motorists stay in the appropriate lane.

WHY WAS THIS CHOSEN FOR TAHOE?

- Wrong-side-of-road and unsafe lane change crashes are associated with fatal and severe injury outcomes in the Tahoe Region.
- Delineators, reflectors, or object markers would improve driver awareness of approaching turns and help drivers stay in their lane through curves.

PLACEMENT & DESIGN CONSIDERATIONS

- Suitable to all roadways with sharp curves and fixed objects on the roadside.
- Combining with chevron signs or dynamic speed feedback signs may increase effectiveness, but roadway scenic clutter should also be considered.
- Winter maintenance practices may need to be modified to accommodate these, or they may need to be removed during months when snowfall may occur.



Photo: Kittelson & Associates, Inc.

CRASHES

APPLICABLE TYPES

ALL



POTENTIAL
CRASH
REDUCTION*

APPROXIMATE COST

\$60

PER ITEM

EXPECTED DESIGN LIFE

10
YEARS

IMPLEMENTATION TIME FRAME



MEDIUM

ADDITIONAL INFO

- [Caltrans Local Roadway Safety Plan](#)
- [FHWA Proven Safety Countermeasures](#)

* Caltrans, "Local Roadway Safety Manual," Version 1.5, April 2020.

EDGE TREATMENT

REMOVE, RELOCATE, OR PROTECT FIXED OBJECTS ADJACENT TO ROAD

This treatment provides clear space or protection, increasing recovery time for drivers to correct their path if they leave the roadway.

WHY WAS THIS CHOSEN FOR TAHOE?

- Single-vehicle crashes are common at the outside edge of curved roads in the Tahoe Region.

PLACEMENT & DESIGN CONSIDERATIONS

- The width of the clear zone should be based on exposure, including traffic volumes, speeds, and side slopes.
- More effective in rural areas in presence of highway-like facilities. In developed areas the presence of fixed objects along a road can have a traffic calming effect.
- Not all fixed objects are feasible to be removed or relocated. Making objects more visible or installing roadside barriers to shield unmovable objects may also be an appropriate treatment.
- Competing interests should be considered, including the environmental benefits of trees, safety benefits of removed roadside parking, or a need for utilities next to the road.



Photo: Kittelson & Associates, Inc.

CRASHES

APPLICABLE TYPES

**FIXED
OBJECT**

35% POTENTIAL
CRASH
REDUCTION*

APPROXIMATE COST

\$10K-100K
PER OBJECT**

EXPECTED DESIGN LIFE

20
YEARS

IMPLEMENTATION TIME FRAME



SHORT to
MEDIUM

ADDITIONAL INFO

- [Caltrans Local Roadway Safety Plan](#)
- [FHWA Proven Safety Countermeasures](#)

* Caltrans, "Local Roadway Safety Manual," Version 1.5, April 2020.

** Costs depend on whether objects can be easily relocated/removed. Cost estimate is implementation cost from FHWA.

SPEED MANAGEMENT

VARIABLE SPEED LIMITS

Variable speed limits use prevailing information on the roadway, like traffic speed, volumes, weather, and road surface conditions, to determine appropriate speeds and display them to drivers.

WHY WAS THIS CHOSEN FOR TAHOE?

- Conditions in Tahoe are susceptible to change in a short period of time, due to congestion, crashes, or winter weather. Variable speed limits can adapt to changing conditions to bring drivers to appropriate speeds.

PLACEMENT & DESIGN CONSIDERATIONS

- Particularly effective on urban and rural freeways and high-speed arterials with speed limits greater than 40 mph and high traffic volumes.
- May pair with dynamic message signs (DMS) to provide explanations for reduced speed or traveler information, with careful consideration of scenic implications of DMS.
- Requires technology investments, including corridor-wide vehicle detection, environmental sensors and other weather detection, and closed-circuit television (CCTV) cameras for verification and monitoring.
- May require additional law enforcement resources.



Photo: VDOT

CRASHES

APPLICABLE TYPES

UNSAFE SPEED



POTENTIAL
CRASH
REDUCTION*

APPROXIMATE COST

\$1M**

PER DIRECTIONAL MILE

EXPECTED DESIGN LIFE

15
YEARS

IMPLEMENTATION TIME FRAME



LONG

ADDITIONAL INFO

- [FHWA Proven Safety Countermeasures](#)
- [California Vehicle Code](#)
- [Nevada Traffic Laws](#)

* FHWA, "Proven Safety Countermeasures"

**34% for total crashes, 65% reduction for rear-end, and 51% for fatal and injury crashes

**Approximately \$40k is estimated for yearly maintenance of system by National Center for Rural Roadway Safety.

TRUCK CLIMBING LANE

Truck climbing lanes address conflicts between passenger vehicles and slower trucks on inclined roadways and can help reduce the likelihood of motorists passing slow-moving trucks in no-passing zones.

WHY WAS THIS CHOSEN FOR TAHOE?

- In the Tahoe Region, potential conflicts are generated along state facilities by the presence of steep grades, trucks, and inconsistent weather conditions.
- Climbing lanes separate slower traffic, producing more consistent speeds and fewer crashes.

PLACEMENT & DESIGN CONSIDERATIONS

- Truck climbing lanes should be considered where steep grades slow heavy vehicle speeds, resulting in vehicle platoons (typically 5% grades and steeper).
- Truck traffic volumes should be considered when determining if a climbing lane is appropriate.
- Environmental impacts such as grading and increased coverage should be considered in cost-benefit analysis.



Photo: Kittelson & Associates, Inc.

CRASHES

APPLICABLE TYPES

ALL

43%

POTENTIAL
CRASH
REDUCTION*

APPROXIMATE COST

\$3,000

PER LINEAR FOOT

EXPECTED DESIGN LIFE

20
YEARS

IMPLEMENTATION TIME FRAME



LONG

ADDITIONAL INFO

- [Crash Modification Factors Clearinghouse](#)

**Haq, M.T., M. Zlatkovic, and K. Ksaibati. "Evaluating Safety Effectiveness of Truck Climbing Lanes using Cross-Sectional Analysis and Propensity Score Models" (2019).*

ACCELERATION/ DECELERATION LANES

An acceleration lane allows vehicles to accelerate to highway speeds (high speed roadways) before entering the through traffic lanes of a highway. A deceleration lane allows vehicles to provide the opportunity to safely decelerate to negotiate a turning movement.

WHY WAS THIS CHOSEN FOR TAHOE?

- In the Tahoe Region, conflicts are generated along state facilities where there are unsignalized turns, no dedicated turn lane, and high speeds.

PLACEMENT & DESIGN CONSIDERATIONS

- Areas proven to have crashes that are the result of drivers not being able to turn onto a high speed roadway to accelerate until the desired roadway speed is reached and areas that do not provide the opportunity to safely decelerate to negotiate a turning movement.



Photo: Kittelson & Associates, Inc.

CRASHES

APPLICABLE TYPES

**SIDESWIPE,
REAR-END**



POTENTIAL
CRASH
REDUCTION*

APPROXIMATE COST

\$3,000

PER LINEAR FOOT

EXPECTED DESIGN LIFE

20
YEARS

IMPLEMENTATION TIME FRAME



LONG

ADDITIONAL INFO

- [Caltrans Local Roadway Safety Plan](#)

*Caltrans, "Local Roadway Safety Manual," Version 1.5, April 2020.

A dark gray trapezoidal graphic element with a diagonal cut on the left side, extending from the bottom left towards the center of the page.

02 INTERSECTIONS

Any Land Use Condition

ALL INTERSECTIONS

TRPA APPROVED INTERSECTION LIGHTING

Intersection lighting improves visibility and sight distance, especially for non-motorized users.

WHY WAS THIS CHOSEN FOR TAHOE?

- Appropriate along corridors with mixed land use and pedestrian or bicycle activity.
- Lighting illuminates crossings, helping pedestrians to navigate crossings; it increases pedestrian visibility and improves advanced warning for motorists.

PLACEMENT & DESIGN CONSIDERATIONS

- TRPA-approved lighting should be designed to illuminate conflict areas at crossings and intersections as well as along paths of travel while being consistent with dark-sky guidelines to reduce light pollution.
- In rural areas primarily served by auto traffic, conventional 1 or 2-arm fixtures are appropriate. In areas where bike/peds are expected and traffic calming is desired, shorter fixtures (Height < 15 feet) create vertical enclosure at night for drivers and create comfortable conditions for bike/peds.



Photo: Kittelson & Associates, Inc.

CRASHES

APPLICABLE TYPES

NIGHT CRASHES

40% POTENTIAL
CRASH
REDUCTION*

APPROXIMATE COST

\$9K
PER LIGHT

EXPECTED DESIGN LIFE

20
YEARS

IMPLEMENTATION TIME FRAME

● ○ ○ SHORT

ADDITIONAL INFO

- [Caltrans Local Roadway Safety Plan](#)
- [FHWA Proven Safety Countermeasures](#)
- [TRPA Code of Ordinances](#)

* Caltrans, "Local Roadway Safety Manual," Version 1.5, April 2020.

CURB EXTENSIONS/BULB-OUTS



Photo: Luxuri Media

Curb extensions, or bulb-outs, extend the sidewalk into the parking lane, either at corners or mid-block locations. Bulb-outs reduce vehicle turning speed, decrease pedestrian crossing distance, and reduce near-misses between pedestrians and vehicles.

WHY WAS THIS CHOSEN FOR TAHOE?

- Curb extensions can enhance pedestrian safety by reducing crossing distances and slowing vehicle speed, can relieve sidewalk crowding, and can provide space for functional elements.

PLACEMENT & DESIGN CONSIDERATIONS

- Should be used where there is a parking lane and where transit and cyclists would be traveling outside the curb edge for the length of the street.
- Must be designed with snow plowing and street sweeping in mind. Consider rolled curb and marking with objects visible to operators. Ensure snow removal equipment and emergency responder vehicles can safely maneuver turns.
- May implement a temporary measure with bollards or paint to pilot before implementing permanent bulbouts.
- Per AB143, vehicle parking is prohibited within 15ft of a crosswalk if a curb extension is present.

CRASHES

APPLICABLE TYPES

**PEDESTRIANS
AND BIKES**



POTENTIAL
CRASH
REDUCTION*

APPROXIMATE COST

\$2K-20K

PER CORNER***

EXPECTED DESIGN LIFE

10
YEARS

IMPLEMENTATION TIME FRAME



MEDIUM

ADDITIONAL INFO

- [Caltrans Local Roadway Safety Plan](#)
- [NACTO Street Design Elements](#)

*Research is still building and potential crash reductions are not yet published.

**HSIP eligibility is for Install/upgrade pedestrian crossing (with enhanced safety features) which includes, but not limited to, curb extensions.

***FHWA, "Curb Extensions," Countermeasure Library.

SIGNALIZED INTERSECTION

PEDESTRIAN COUNTDOWN SIGNAL HEADS

Countdown signal heads clearly identify the available time for pedestrians to cross the street.

WHY WAS THIS CHOSEN FOR TAHOE?

- Appropriate along corridors with mixed land uses with pedestrian presence, or at intersections with pedestrian activity.
- Countdown signal heads allow pedestrians to know how much time remains to cross, and decreases pedestrian crossing during the "Don't Walk" interval.

PLACEMENT & DESIGN CONSIDERATIONS

- Suitable for longer-distance crossings (> 7 seconds) to inform pedestrians of remaining time.
- Typically installed network-wide or subarea-wide to create consistency for pedestrians.
- When constructing or upgrading pedestrian crossings, review current ADA guidelines to ensure crossings meet current standards.
- In California, bicyclists can legally cross during the pedestrian walk signal if that phase differs from the green light for cars.

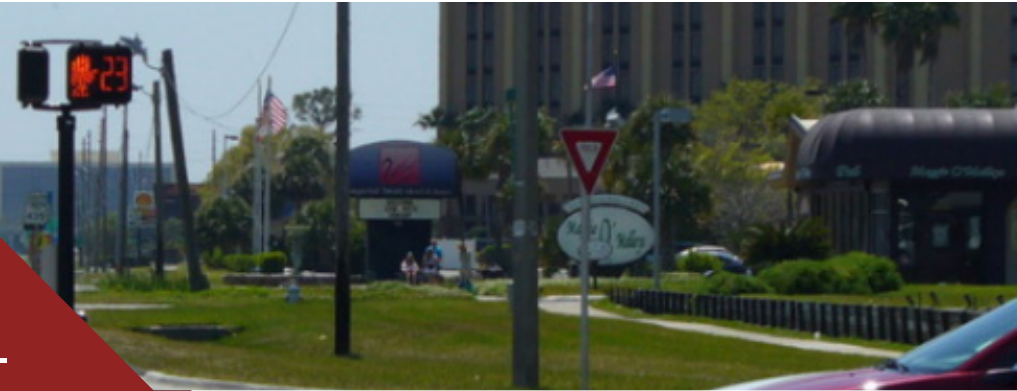


Photo: Kittelson & Associates, Inc.

CRASHES

APPLICABLE TYPES

**PEDESTRIANS
AND BIKES**

25% POTENTIAL
CRASH
REDUCTION*

APPROXIMATE COST

\$1,200
PER SIGNAL HEAD

EXPECTED DESIGN LIFE

20
YEARS

IMPLEMENTATION TIME FRAME

● ○ ○ SHORT

ADDITIONAL INFO

- [Caltrans Local Roadway Safety Plan](#)
- [MUTCD Ch. 4E](#)

* Caltrans, "Local Roadway Safety Manual," Version 1.5, April 2020.

SIGNALIZED INTERSECTION

SIGNAL TIMING ADJUSTMENTS

Signal timing modifications can help reduce turning conflicts and manage speeds along a corridor. Modifications may include re-timing the yellow change interval or all-red clearance interval, adding or adjusting signal phases, or coordinating signals to manage speed on a corridor.

WHY WAS THIS CHOSEN FOR TAHOE?

- Appropriate in areas with rear-end or turning movement crashes at a signalized intersection or series of intersections and crashes involving turning vehicles and pedestrians or bicyclists crossing the street.
- Candidate locations for improved signal timing in the Tahoe Region include transition areas along state facilities that pass through corridors with mixed land uses.

PLACEMENT & DESIGN CONSIDERATIONS

- Latest MUTCD guidance should be used for determining appropriate phasing, clearance times, and timing strategies.
- Phasing and timing plans may be limited by available equipment and may require upgraded signal hardware.
- Understanding the corridor as a holistic system is key. Signal timing adjustments work well to decrease collisions throughout multiple intersections.



Photo: Kittelson & Associates, Inc.

CRASHES

APPLICABLE TYPES

ALL

15%

POTENTIAL
CRASH
REDUCTION*

APPROXIMATE COST

\$6K

PER INTERSECTION**

EXPECTED DESIGN LIFE

10
YEARS

IMPLEMENTATION TIME FRAME



MEDIUM

ADDITIONAL INFO

- [Caltrans Local Roadway Safety Plan](#)
- [FHWA Proven Safety Countermeasures](#)

* Caltrans, "Local Roadway Safety Manual," Version 1.5, April 2020.

** Cost assumes changes are feasible with existing hardware and does not include hardware updates.

SIGNALIZED INTERSECTION

ADVANCE DILEMMA ZONE DETECTION

Advance dilemma zone detection identifies oncoming vehicles and adjusts timing (e.g., extends a yellow phase) to reduce potential conflicts.

WHY WAS THIS CHOSEN FOR TAHOE?

- This treatment would be appropriate at signalized intersections with a concentration of rear-end or angle crashes at signalized intersections in the Tahoe Region.
- Advance dilemma zone detection reduces the frequency of vehicles entering an intersection during a red phase.

PLACEMENT & DESIGN CONSIDERATIONS

- Suitable for high-speed approaches of 40 mph or greater to a signalized intersection or locations with frequent red-light violations.
- It may be possible to leverage existing detector loops or cameras, although older signal controller equipment may need to be upgraded.
- Additional traffic calming countermeasures should be considered either before or in addition to increase driver awareness as they approach the Dilemma Zone.



Photo: Kittelson & Associates, Inc.

CRASHES

APPLICABLE TYPES

**RIGHT ANGLE,
REAR-END**

40% POTENTIAL
CRASH
REDUCTION*

APPROXIMATE COST

\$6K
PER SYSTEM**

EXPECTED DESIGN LIFE

10***
YEARS

IMPLEMENTATION TIME FRAME

● ● ○ MEDIUM

ADDITIONAL INFO

- [Caltrans Local Roadway Safety Plan](#)

* Caltrans, "Local Roadway Safety Manual," Version 1.5, April 2020.

** Cost assumes changes are feasible with existing hardware and does not include hardware updates.

SIGNALIZED INTERSECTION

ADAPTIVE SIGNAL TIMING

Adaptive timing adjusts signal and phase timing in response to current traffic patterns to promote smooth flow of traffic.

WHY WAS THIS CHOSEN FOR TAHOE?

- In the Tahoe Region, travel patterns vary significantly by season and can change unexpectedly due to weather, special events, and crashes.
- The presence of rear-end crashes at intersections indicates potential benefits to improving traffic flow.

PLACEMENT & DESIGN CONSIDERATIONS

- Before implementing, consider evaluating the benefit of implementing at multiple locations along a corridor (and potential for crossing jurisdictions).
- Consider what adaptive technologies will work best under local conditions (there are a variety of systems that operate best in varied environments).
- Some adaptive traffic control systems adjust some of their parameters every few seconds, others adjust parameters every 10 to 15 min.
- Systems can give priority to transit vehicles.



Photo: Kittelson & Associates, Inc.

CRASHES

APPLICABLE TYPES

ALL



POTENTIAL
CRASH
REDUCTION*

17%

APPROXIMATE COST

\$65K

PER SYSTEM**

EXPECTED DESIGN LIFE

2

YEARS***

IMPLEMENTATION TIME FRAME



MEDIUM

ADDITIONAL INFO

- [National Cooperative Highway Research Program \(NCHRP\) Synthesis](#)

* Ma et al., "Estimation of the Safety Effects of an Adaptive Signal Control System," *Journal of Transportation Engineering*, Volume 142, Issue 12 (2016).

***Design life may differ depending on local signal timing practice.

SIGNALIZED INTERSECTION

LEADING PEDESTRIAN INTERVAL AT TRAFFIC SIGNAL



Photo: Kittelson & Associates, Inc.

Leading pedestrian intervals (LPIs) allow pedestrians to start crossing in advance of turning motorists. The treatment makes pedestrians more visible to turning vehicles, making drivers more likely to yield to pedestrians crossing the street.

WHY WAS THIS CHOSEN FOR TAHOE?

- Multilane crossings along mixed land use corridors were noted as a pedestrian risk factor in the Tahoe Region.
- LPIs give pedestrians a head start, making them more visible to motorists.

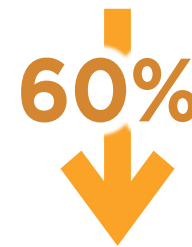
PLACEMENT & DESIGN CONSIDERATIONS

- LPIs provide a minimum head start of 3-7 seconds, depending on crossing distance.
- May be combined with curb extensions to improve visibility of pedestrians to motorists at high-conflict intersections or in combination with signs reminding motorists that turning vehicles are required to yield to pedestrians.
- In California, bicycles may cross on pedestrian walk signals, so an LPI may benefit bicyclist users as well.

CRASHES

APPLICABLE TYPES

**PEDESTRIANS
AND BIKES**



POTENTIAL
CRASH
REDUCTION*

APPROXIMATE COST

\$1K-3K

PER CROSSING

EXPECTED DESIGN LIFE

10
YEARS

IMPLEMENTATION TIME FRAME



SHORT

ADDITIONAL INFO

- [Caltrans Local Roadway Safety Plan](#)
- [FHWA Proven Safety Countermeasures](#)

* Fayish, A.C. and F. Gross, "Safety Effectiveness of Leading Pedestrian Intervals Evaluated by a Before-After Study with Comparison Groups." Transportation Research Record No. 2198 (2010).

SIGNALIZED INTERSECTION

EXCLUSIVE PEDESTRIAN PHASING

Exclusive pedestrian phasing stops all vehicular movement and allows pedestrians to cross in any direction (including diagonally).

WHY WAS THIS CHOSEN FOR TAHOE?

- Appropriate for intersections that serve higher pedestrian volumes during peak tourist seasons.
- Record of multiple pedestrian crashes at intersections along mixed land use corridors in the Tahoe Region.

PLACEMENT & DESIGN CONSIDERATIONS

- Exclusive pedestrian phasing is most effective in locations that serve 1,200 pedestrians per day and are less than 60 feet to cross.¹
- This treatment reduces pedestrian crossing time and exposure, shown to reduce injury risk of pedestrians from conflict with vehicles.
- It may result in longer cycle lengths at intersections with long diagonal crossing distances, increasing total delay for vehicles.
- Snow and ice reduce the effective life of pavement markings and require more frequent maintenance.



Photo: Kittelson & Associates, Inc.

CRASHES

APPLICABLE TYPES

**PEDESTRIANS
AND BIKES**

40%

POTENTIAL
CRASH
REDUCTION*

APPROXIMATE COST

\$12K

PER INTERSECTION

EXPECTED DESIGN LIFE

20**
YEARS

IMPLEMENTATION TIME FRAME



SHORT to
MEDIUM

ADDITIONAL INFO

- [Caltrans Local Roadway Safety Plan](#)

* Caltrans, "Local Roadway Safety Manual," Version 1.5, April 2020.

** Design life may differ depending on local signal timing practice. Repainting will be needed sooner, typically every 1-3 years.

1. Bonneson et al., Development of Guidelines for Pedestrian Safety Treatments at Signalized Intersections.

SIGNALIZED INTERSECTION

ADVANCE STOP BAR BEFORE CROSSWALK (BIKE BOX)

Bike boxes increase separation between stopped vehicles and crosswalks at intersections. They create designated, visible space for bicyclists to wait at a red light and also provide additional space between people crossing the street and motor vehicles.

WHY WAS THIS CHOSEN FOR TAHOE?

- Appropriate for corridors with mixed land uses with pedestrian and bicyclist presence or a history of pedestrian or bicyclist crashes.
- Bike boxes provide a buffer from vehicles for pedestrians crossing and provide space for bicyclists at the stop bar. Bike boxes increase motorist awareness of bicyclist presence.

PLACEMENT & DESIGN CONSIDERATIONS

- Suitable in locations where bikes are present or encroachment into crosswalk is common.
- Snow and ice reduce the effective life of pavement markings and require more frequent maintenance.
- Consider use of colored asphalt to reduce maintenance and extend design life.



Photo: Kittelson & Associates, Inc.

CRASHES

APPLICABLE TYPES

**PEDESTRIANS
AND BIKES**



POTENTIAL
CRASH
REDUCTION*

APPROXIMATE COST

\$1,200

PER APPROACH

EXPECTED DESIGN LIFE

1-5
YEARS***

IMPLEMENTATION TIME FRAME



SHORT

ADDITIONAL INFO

- [Caltrans Local Roadway Safety Plan](#)

* Caltrans, "Local Roadway Safety Manual," Version 1.5, April 2020.

**While bike boxes may last up to 10 years in other locations, repainting is typically required every year to 5 years in Tahoe.

SIGNALIZED INTERSECTION

BACKPLATES WITH RETROREFLECTIVE BORDERS

Signal heads that have backplates equipped with retroreflective borders are more visible and conspicuous in daytime, nighttime, and power outage conditions.

WHY WAS THIS CHOSEN FOR TAHOE?

- Suitable for signalized intersections with a high frequency of right-angle and rear-end crashes occurring because drivers are unable to see traffic signals sufficiently in advance to safely negotiate the intersection.
- This countermeasure is 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.

PLACEMENT & DESIGN CONSIDERATIONS

- For older signals where new backplates will not fit, consider adding reflective tape to existing backplates.
- Agencies should consider the design of the existing signal support structure to determine if the design is sufficient to support the added wind load.
- Factor in maintenance to ensure reflective materials do not degrade in harsh winters.

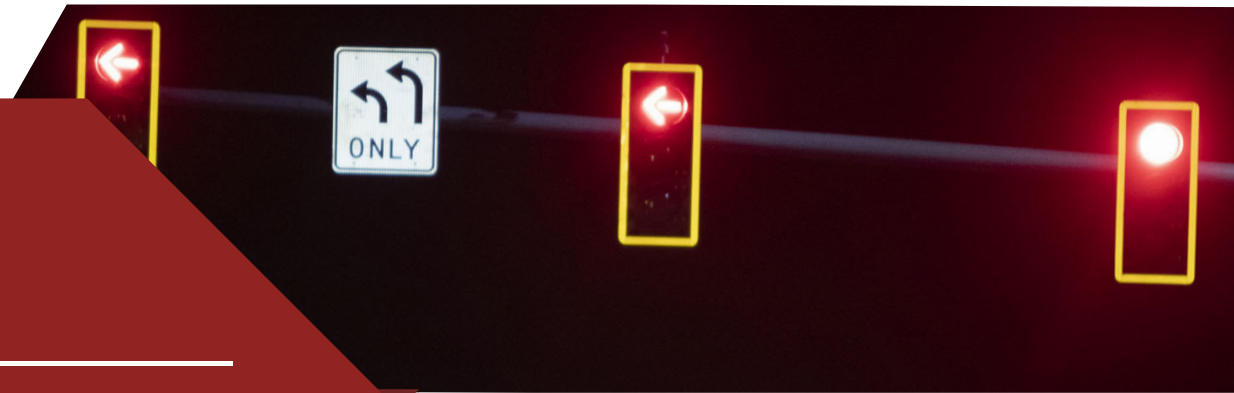


Photo: Nevada Department of Transportation

CRASHES

APPLICABLE TYPES

ALL



POTENTIAL
CRASH
REDUCTION*

APPROXIMATE COST

\$35 **\$110**

PER HEAD TO
ADD TAPE**

PER NEW
BACKPLATE**

EXPECTED DESIGN LIFE

10
YEARS*

IMPLEMENTATION TIME FRAME



SHORT

ADDITIONAL INFO

- [Caltrans Local Roadway Safety Plan](#)
- [FHWA Proven Safety Countermeasures](#)

* Caltrans, "Local Roadway Safety Manual," Version 1.5, April 2020.

**Connecticut Transportation Institute, "Retroreflective Backplates — A Proven Safety Countermeasure," Technical Brief, 2019.

SIGNALIZED INTERSECTION

PROTECTED INTERSECTIONS



Photo: Kittelson & Associates, Inc.

Protected intersections include a corner refuge island, a forward stop bar, and setback crossings to provide physical separation for bicylists, reduce crossing distance for pedestrians, and reduce vehicle turning speed.

WHY WAS THIS CHOSEN FOR TAHOE?

- Countermeasures that rely on pavement markings have reduced effectiveness in winter due to snowfall and require more often maintenance. Hardscape alternatives such as protected intersections are more effective year-round.

PLACEMENT & DESIGN CONSIDERATIONS

- Corner areas may be a shared bicycle/pedestrian area through shared-use paths rather than exclusive separated bike lanes and parallel pedestrian sidewalks.
- When converting existing intersections, drainage may have to be relocated, which can be a major cost.
- Consider combining with lane reduction projects, as there is more space for reconfiguring the intersection.
- Design protected intersection turn radii with appropriate vehicles' turn templates ensuring large trucks and emergency vehicles can sufficiently navigate the turn.
- Consider both O&M and safety when selecting curb design. A rolled curb may be easier for a snowplow to clear, but is also easier to mount by vehicles.

CRASHES

APPLICABLE TYPES

**PEDESTRIANS
AND BIKES**



POTENTIAL
CRASH
REDUCTION*

APPROXIMATE COST

\$100K-300K
PER INTERSECTION

EXPECTED DESIGN LIFE

10**
YEARS

IMPLEMENTATION TIME FRAME



MEDIUM

ADDITIONAL INFO

- [NACTO Protected Intersections](#)

**Research is still building and crash reduction potentials are not yet published..*

***For the hardscape elements. The green paint bike lanes and bike boxes and crosswalk striping will require more frequent maintenance, every 1-5 years.*

UNSIGNALIZED INTERSECTION

INTERSECTION PAVEMENT MARKINGS

Legible pavement markings enhance an approaching driver's awareness of an unsignalized intersection or crosswalk.

WHY WAS THIS CHOSEN FOR TAHOE?

- Pavement markings at the approach to an intersection alert drivers to the need to stop, be aware of cross traffic, or be aware of pedestrians crossing.
- Stop-controlled intersections of highways and minor streets are a risk factor in crashes in the Tahoe Region.

PLACEMENT & DESIGN CONSIDERATIONS

- *Intersection ahead* pavement markings can be useful to increase motorist awareness of an upcoming, potentially difficult-to-see intersection.
- 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.
- Snow and ice reduce the effective life of pavement markings and require more frequent maintenance.



Photo: Kittelson & Associates, Inc.

CRASHES

APPLICABLE TYPES

ALL



POTENTIAL
CRASH
REDUCTION*

APPROXIMATE COST

\$3K

PER INTERSECTION**

EXPECTED DESIGN LIFE

1-5
YEARS***

IMPLEMENTATION TIME FRAME



SHORT

ADDITIONAL INFO

- [Caltrans Local Roadway Safety Plan](#)
- [FHWA Proven Safety Countermeasures](#)

* Caltrans, "Local Roadway Safety Manual," Version 1.5, April 2020.

**Cost estimate is from 2019 and needs evaluated on project-specific basis.

***While bike boxes may last up to 10 years in other locations, repainting is typically required every year to 5 years in Tahoe.

UNSIGNALIZED INTERSECTION

ROUNDAABOUT



Photo: PEDSAFE

Converting a signal or stop-controlled intersection to a roundabout reduces turning conflicts and limits speeds through the intersection. Roundabout design is important to protect vulnerable road users.

WHY WAS THIS CHOSEN FOR TAHOE?

- Improper turning and unsafe speeds are two of the most common collision factors in the Tahoe Region.
- Roundabouts help manage speeds, eliminate conflict from left-turning movements, and reduce the severity of crashes.

PLACEMENT & DESIGN CONSIDERATIONS

- Most appropriate where pedestrian volumes are low. If pedestrian volumes are high, signal controls and larger crosswalk widths should be used.
- Include raised crossings and pedestrian hybrid beacons to better provide for visually-impaired pedestrians.
- ADA compliant pedestrian crosswalks and curb ramps should be at least 20 feet from the entry of the roundabout.
- Truck aprons should be included to safely accommodate truck turning radius.
- Special considerations need to be taken for multi-lane roundabouts, as safety benefits for pedestrians and bicycles are reduced compared to single lane.

CRASHES

APPLICABLE TYPES

ALL

12-78% POTENTIAL CRASH REDUCTION*

APPROXIMATE COST

\$2M-10M

PER INTERSECTION

EXPECTED DESIGN LIFE

20
YEARS

IMPLEMENTATION TIME FRAME

● ● ● LONG

ADDITIONAL INFO

- [Caltrans Local Roadway Safety Plan](#)
- [FHWA Proven Safety Countermeasures](#)
- [NCHRP Report 672](#)

*Caltrans, "Local Roadway Safety Manual," Version 1.5, April 2020.

*Multi-lane roundabouts are associated with smaller reductions in crashes compared to single-lane roundabouts

A dark gray trapezoidal graphic element with a diagonal cut on the left side, containing white text.

03 ROADWAY SEGMENTS

Mixed Land Uses, Multimodal

ACCESS MANAGEMENT

RAISED MEDIAN



Photo: PEDSAFE

Raised medians clearly demark opposing directions of traffic and direct turning movements to appropriate locations.

WHY WAS THIS CHOSEN FOR TAHOE?

- Improper turning movements constitute the second-most-common collision factor in the Tahoe Region.
- Raised medians channelize turn movements to specific locations where storage and adequate site distance can be provided.

PLACEMENT & DESIGN CONSIDERATIONS

- Consider both O&M and safety when selecting curb design. A rolled curb may be easier for a snowplow to clear, but is also easier to mount by vehicles.
- Consider median placement in the context of the broader corridor where it will be placed and the corresponding impact on access and circulation.
- Consider implementing in tandem with raised and reflective buffers as used in protected bike lanes.

CRASHES

APPLICABLE TYPES

ALL

25% POTENTIAL
CRASH
REDUCTION*

APPROXIMATE COST

\$180
PER LINEAR FOOT

EXPECTED DESIGN LIFE

20
YEARS

IMPLEMENTATION TIME FRAME

● ● ● LONG

ADDITIONAL INFO

- [Caltrans Local Roadway Safety Plan](#)
- [FHWA Proven Safety Countermeasures](#)

* Caltrans, "Local Roadway Safety Manual," Version 1.5, April 2020.

DIRECTIONAL MEDIAN OPENINGS

Medians and openings help to manage access and other conflicts, particularly near intersections.

WHY WAS THIS CHOSEN FOR TAHOE?

- Improper turning movements constitute one of the primary crash factors in the Tahoe Region.
- Directional median openings can manage conflicts in the Tahoe Region by directing access-related movements away from an intersection, separating potential conflicts.

PLACEMENT & DESIGN CONSIDERATIONS

- This treatment can be considered for locations with frequent turning-related crashes at access points.
- For higher speed approaches, consider vehicle storage needs based on the anticipated demand for left-turns to help reduce the risk of rear-end crashes on the major street approaches.
- Consider implementation as part of an access management plan, rather than as a spot treatment.
- Adjustments to snow plow operations may be needed during winter snow conditions.

CRASHES

APPLICABLE TYPES

ALL

50% POTENTIAL
CRASH
REDUCTION*

APPROXIMATE COST

\$25K

PER MEDIAN OPENING

EXPECTED DESIGN LIFE

20
YEARS

IMPLEMENTATION TIME FRAME

● ● ● LONG

ADDITIONAL INFO

- [Caltrans Local Roadway Safety Plan](#)
- [FHWA Proven Safety Countermeasures](#)

* Caltrans, "Local Roadway Safety Manual," Version 1.5, April 2020.

Photo: Kittelson & Associates, Inc.

ACCESS MANAGEMENT

DRIVEWAY ACCESS MANAGEMENT

Medians and openings help to manage access and other conflicts, particularly near intersections.

WHY WAS THIS CHOSEN FOR TAHOE?

- Every intersection, from a signalized intersection to an unpaved driveway, has the potential for conflicts between vehicles, pedestrians, and bicyclists.
- Improper turning is a primary crash factor in Tahoe.

PLACEMENT & DESIGN CONSIDERATIONS

- In addition to turning related crashes at access points, the speed difference between through traffic and turning traffic may lead to angle-broadside or rear-end crashes.
- Strategies include driveway closure, consolidation, or relocation and limiting allowable movements at driveways (such as right-in/right-out only).
- Placing driveways on an intersection approach corner rather than a receiving corner is expected to have fewer total crashes.
- May combine with medians that preclude across-roadway movements.

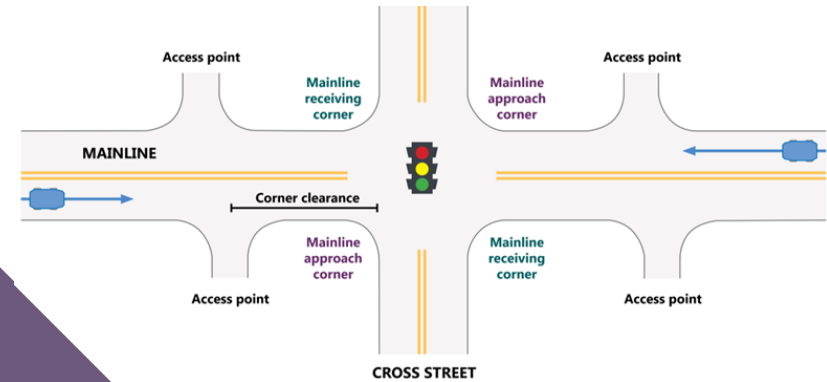


Photo: FHWA

CRASHES

APPLICABLE TYPES

ALL



POTENTIAL
CRASH
REDUCTION*

5-31%

APPROXIMATE COST

VARIES

EXPECTED DESIGN LIFE

NA

IMPLEMENTATION TIME FRAME



LONG

ADDITIONAL INFO

- [FHWA Proven Safety Countermeasures](#)

* FHWA, "Proven Safety Countermeasures."

* 5-23% reduction in crashes along 2-lane rural roads, 25-31% reduction in fatal and injury crashes along urban/suburban arterials.

PEDESTRIAN CROSSING

RAISED MEDIANS/ REFUGE ISLANDS

Raised medians with refuge islands decrease pedestrian crossing distance lengths and exposure to vehicle traffic.

WHY WAS THIS CHOSEN FOR TAHOE?

- Multilane uncontrolled crossings are associated with a higher number of pedestrian crashes in the Tahoe Region.
- Refuge islands would shorten crossing length, allowing pedestrians to cross one direction of traffic at a time.

PLACEMENT & DESIGN CONSIDERATIONS

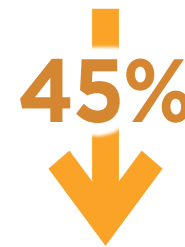
- Median must have at least 6 feet of clear width to accommodate people using wheelchairs.
- At crossing locations where bicyclists are anticipated, a width of 10 feet is desirable to accommodate bicycles with trailers or groups of bicyclists.
- Most appropriate in areas with a high pedestrian volumes, traffic volumes over 9,000 vehicles per day, and travel speeds 35 mph or greater.
- Consider both O&M and safety when selecting curb design. A rolled curb may be easier for a snowplow to clear, but is also easier to mount by vehicles.

Photo: Kittelson & Associates, Inc.

CRASHES

APPLICABLE TYPES

**PEDESTRIANS
AND BIKES**



POTENTIAL
CRASH
REDUCTION*

45%

APPROXIMATE COST

\$25

PER SQUARE FOOT

EXPECTED DESIGN LIFE

20
YEARS

IMPLEMENTATION TIME FRAME



LONG

ADDITIONAL INFO

- [Caltrans Local Roadway Safety Plan](#)
- [FHWA Proven Safety Countermeasures](#)

* Caltrans, "Local Roadway Safety Manual," Version 1.5, April 2020.

PEDESTRIAN CROSSING

ENHANCED PEDESTRIAN CROSSING AT UNCONTROLLED LOCATIONS



Photo: Kittelson & Associates, Inc.

Treatments that enhance the visibility of pedestrian crossings help alert drivers to the need to slow their speed and potential need to stop if pedestrians are present.

WHY WAS THIS CHOSEN FOR TAHOE?

- Appropriate in Tahoe's mixed land use corridors with pedestrian presence or a history of pedestrian crashes.
- Enhanced pedestrian crossings help increase crossing visibility and promote motorist yielding behavior.

PLACEMENT & DESIGN CONSIDERATIONS

- Consider combining with complementary treatments, such as a flashing beacons, curb extensions, advanced road markings, and/or dynamic speed warning sign on high-speed roadways.
- Consider the need for lighting at the crossing to provide appropriate visibility of the crossing and pedestrians during dawn, dusk, and night conditions.
- The RRFB is particularly effective at multilane crossings with speed limits less than 40mph.
- Per [AB413](#), crosswalks must be daylighted with no parking within 20ft.

CRASHES

APPLICABLE TYPES

PEDESTRIANS

35%

POTENTIAL
CRASH
REDUCTION*

APPROXIMATE COST

\$3K-20K

EXPECTED DESIGN LIFE

20
YEARS***

IMPLEMENTATION TIME FRAME



SHORT to
MEDIUM

ADDITIONAL INFO

- [Caltrans Local Roadway Safety Plan](#)
- [FHWA Proven Safety Countermeasures](#)

* Caltrans, "Local Roadway Safety Manual," Version 1.5, April 2020.

20% for signs and markings; 47% if include rectangular flashing beacon.

** \$3,000 for new signs and markings; \$20,000 if include flashing beacon.

*** 10 years for signs and markings; 20 years for flashing beacon.

PEDESTRIAN CROSSING

PEDESTRIAN HYBRID BEACON (PHB OR HAWK)

By stopping motor vehicle traffic, pedestrian hybrid beacons help to create gaps in traffic for pedestrians to cross the street.

WHY WAS THIS CHOSEN FOR TAHOE?

- Multilane uncontrolled crossings in mixed land use corridors are a risk factor in the Tahoe Region.
- Pedestrian hybrid beacons would aid pedestrian safety by increasing driver awareness and yielding behavior.

PLACEMENT & DESIGN CONSIDERATIONS

- Best suited at locations with 3 or more lanes, vehicle volumes greater than 9,000 per day, and speeds greater than 35mph.
- Time for button to activate beacon should balance need to serve pedestrians in a timely manner with providing sufficient flow and stopping time for vehicles.
- Design so that the button to activate is accessible to all users.
- There is no warrant that needs to be met or satisfied for installation of a PHB.
- Driver and pedestrian education is important prior to installation. Observe compliance after installation and consider additional measures if adequate.



Photo: Kittelson & Associates, Inc.

CRASHES

APPLICABLE TYPES

**PEDESTRIANS
AND BIKES**

55%
↓

POTENTIAL
CRASH
REDUCTION*

APPROXIMATE COST

\$500K

PER SYSTEM

EXPECTED DESIGN LIFE

20
YEARS

IMPLEMENTATION TIME FRAME



MEDIUM

ADDITIONAL INFO

- [Caltrans Local Roadway Safety Plan](#)
- [FHWA Proven Safety Countermeasures](#)

* Caltrans, "Local Roadway Safety Manual," Version 1.5, April 2020.

PEDESTRIAN UNDERPASS



Photo: [Linked with Wanderlust](#)

Pedestrian underpasses provide complete separation of pedestrians and bicyclists from motor vehicle traffic by providing a facility below the roadway.

WHY WAS THIS CHOSEN FOR TAHOE?

- Pedestrian underpasses can help pedestrians safely cross the high-volume, high-speed state routes that circumnavigate the lake, such as the tunnel underneath State Route 28 shown above.

PLACEMENT & DESIGN CONSIDERATIONS

- Most appropriate under high-volume, high-speed highways, or natural barriers where traditional pedestrian facilities are not feasible.
- Minimal widths should be between 14 and 16 ft, but underpass width should be increased if the underpass is longer than 60 ft.
- Lighting, drainage, and safety in tunnels are crucial considerations to make an underpass viable and attractive.
- Underpass must meet ADA Standards to accommodate all users.
- Consider environmental impacts. Only applicable in high capability lands where geo technical studies support infrastructure.

CRASHES

APPLICABLE TYPES

**PEDESTRIANS
AND BIKES**



POTENTIAL
CRASH
REDUCTION**

APPROXIMATE COST

\$2M-10M

EXPECTED DESIGN LIFE

100
YEARS*

IMPLEMENTATION TIME FRAME



LONG

ADDITIONAL INFO

- [FHWA The Walking Environment](#)

**City of Fort Collins, "Design Guidelines for Grade-Separated Pedestrian, Cyclist and Equestrian Structures."*

***Further studies are needed to determine crash reduction potential.*

PEDESTRIAN OVERPASS BRIDGE



Photo: Roadrunner Bridge

Pedestrian overpasses provide complete separation of pedestrians from motor vehicle traffic by providing a facility above the roadway.

WHY WAS THIS CHOSEN FOR TAHOE?

- Highways, natural barriers, and limited right of way in Tahoe may be a barrier to traditional pedestrian facilities and require unique solutions.

PLACEMENT & DESIGN CONSIDERATIONS

- Should be implemented sparingly in specific locations. Most appropriate over high-volume, high-speed highways, or natural barriers where traditional pedestrian facilities are not feasible or where crossing time is reduced through an overpass.
- AASHTO Guide for the Planning, Design, and Operation of Pedestrian Facilities recommends pedestrian overpasses be at least 8 feet wide. If the overpass also accommodates bicyclists, the width should be at least 14 ft.
- Overpass must meet ADA Standards to accommodate all users.
- Overpasses need to be convenient and not increase crossing time to encourage pedestrian use.

CRASHES

APPLICABLE TYPES

**PEDESTRIANS
AND BIKES**



POTENTIAL
CRASH
REDUCTION*

APPROXIMATE COST

\$1M-7M

EXPECTED DESIGN LIFE

75
YEARS*

IMPLEMENTATION TIME FRAME



LONG

ADDITIONAL INFO

- [FHWA The Walking Environment](#)

**Colorado Department of Transportation, "Pedestrian Structures."*

ROADWAY CONFIGURATION

SIDEWALK



Photo: TRPA

Sidewalks provide separate space for pedestrians to walk, reducing exposure to motor vehicles and decreasing the likelihood of walking in the roadway.

WHY WAS THIS CHOSEN FOR TAHOE?

- The Tahoe Region includes road segments with no sidewalk provision and a history of pedestrian crashes.
- Sidewalks reduce potential conflicts between pedestrians and vehicles by providing physically separated space for walking.

PLACEMENT & DESIGN CONSIDERATIONS

- Sidewalks and paths should be direct, meandering sidewalks present challenges for visually impaired.
- The minimum width of a sidewalk should be 8 feet between a curb and a building when in urban and rural main street place types. For all other locations, minimum sidewalk should be 6 feet when contiguous to a curb or 5 feet when separated by a planting strip.
- Signage indicating that electric scooter use is illegal on sidewalks can help reduce scooter/pedestrian conflict.

CRASHES

APPLICABLE TYPES

PEDESTRIANS

80% POTENTIAL
CRASH
REDUCTION*

APPROXIMATE COST

\$1M-2M

PER MILE

EXPECTED DESIGN LIFE

20
YEARS

IMPLEMENTATION TIME FRAME



MEDIUM
to LONG

ADDITIONAL INFO

- [Caltrans Local Roadway Safety Manual](#)
- [FHWA Proven Safety Countermeasures](#)

* Caltrans, "Local Roadway Safety Manual," Version 1.5, April 2020.

ROADWAY CONFIGURATION

SHARED USE PATHWAY (CLASS I PATH)



Photo: Luxuri Media

A shared use pathways is a path separated from the roadway by a buffer, for use by all active transportation modes.

WHY WAS THIS CHOSEN FOR TAHOE?

- Shared use paths can provide a low-stress experience and reduce conflict between active modes and vehicles.

PLACEMENT & DESIGN CONSIDERATIONS

- Recommended 10 foot width for moderate usage and 12-14 foot for heavy usage.
- User conflict can be reduced through pavement markings, signage, path widening and education. If regular pedestrian use is anticipated, separate facilities for pedestrians may be beneficial to minimize conflicts.
- Bike paths immediately adjacent to streets and highways may introduce significant conflicts at intersections and are not recommended (CA Highway Design Manual Ch. 1000).
- Intersections with roadways should be designed to reduce vehicle speed and heighten awareness of path users. Right of way assignment should consider not only speed, but volume and relative importance. STOP or YIELD signs should face roadway approaches where feasible.
- Snow removal needs and storage should be considered.

CRASHES

APPLICABLE TYPES

**PEDESTRIANS
AND BIKES**



POTENTIAL
CRASH
REDUCTION*

APPROXIMATE COST

\$10M

PER MILE**

EXPECTED DESIGN LIFE

20
YEARS

IMPLEMENTATION TIME FRAME



MEDIUM
to LONG

ADDITIONAL INFO

- [Caltrans Local Roadway Safety Manual](#)
- [MUTCD Ch. 9B](#)

**When an off-street bike-path is proposed that is not adjacent to the roadway, the implementer must document the engineering judgment used to determine which "Ped & Bike" crashes to apply*

***Varies depending on context, if drainage improvements are included, etc.*

ROADWAY CONFIGURATION

BICYCLE LANES - TRADITIONAL (CLASS 2), BUFFERED (CLASS 2B), GREEN PAINT



Class 2B bike lane, Photo: NACTO

Bike lanes provide dedicated space for bicyclists. Designs may include degrees of physical separation from parked vehicles and moving vehicles.

WHY WAS THIS CHOSEN FOR TAHOE?

- Streets through commercial areas in the Tahoe Region often lack bicycle infrastructure.
- Bike lanes reduce bicycle/vehicle conflicts by separating uses and encouraging more predictable movements from all parties.

PLACEMENT & DESIGN CONSIDERATIONS

- Class 2 lanes must be minimum 4 ft wide, not including the gutter. If posted speeds are greater than 40mph, bike lane should be 6 ft wide.
- Adding buffers increases safety and comfort for bicyclists. Buffers should be at least 2 ft wide. The buffer area shall have interior diagonal cross hatching or chevron markings if 3 ft or wider.
- Green pavement increases visibility and reinforces bicycle priority. May be used along the length of facility, or as spot treatment for high conflict areas.
- Snow can reduce the effective life of pavement markings or paint, requiring more frequent maintenance.

CRASHES

APPLICABLE TYPES

**PEDESTRIANS
AND BIKES**



POTENTIAL
CRASH
REDUCTION*

APPROXIMATE COST

\$60K - 600K

PER MILE**

EXPECTED DESIGN LIFE

20
YEARS

IMPLEMENTATION TIME FRAME



SHORT

ADDITIONAL INFO

- [Caltrans Local Roadway Safety Manual](#)
- [FHWA Proven Safety Countermeasures](#)
- [Rural Design Guide](#)

* Caltrans, "Local Roadway Safety Manual," Version 1.5, April 2020.

Crash reduction applies to traditional bike lane installation.

**60K for Class 2 bike lane, \$140K for Class 2B bike lane, and 600K for 4ft green painted bike lane.

ROADWAY CONFIGURATION

BICYCLE ROUTES (CLASS 3)



Photo: City of Beverly Hills

Bicycle routes are streets designated for bicycle travel and shared with motorists.

WHY WAS THIS CHOSEN FOR TAHOE?

- Class 3 facilities designate preferred routes thorough high demand corridors.
- There are gaps in Tahoe's existing bicycle network. Bicycle routes can be implemented quickly to close gaps and provide connections, while Class 1, 2, and 4 facilities take longer to implement.

PLACEMENT & DESIGN CONSIDERATIONS

- Established through signage and sharrow markings.
- On streets parallel with and in close proximity to major thoroughfares (1/4 mile or less), with travel speeds 25 mph or less, and traffic volumes fewer than 3,000 vehicles per day.
- Intersection crossings should be designed to enhance safety and minimize delay for bicyclists.
- Per CA Highway Design Manual Ch. 1000, responsible agencies are to take actions to assure routes are suitable as shared routes and will be maintained in a manner consistent with the needs of bicyclists.

CRASHES

APPLICABLE TYPES

**PEDESTRIANS
AND BIKES**



POTENTIAL
CRASH
REDUCTION*

APPROXIMATE COST

\$5K

PER MILE***

\$250 PER SHARROW, \$300 PER SIGN

EXPECTED DESIGN LIFE

10**
YEARS

IMPLEMENTATION TIME FRAME



SHORT

ADDITIONAL INFO

- [CA Highway Design Manual Ch. 1000](#)

*There are no crash modification factors available for this treatment.

**Sharrows need repainted every 1-5 years due to winter deterioration. Signage is expected to last up to 10 years.

***Portland State University, "Cost Analysis of Bicycle Facilities," June 2013.

ROADWAY CONFIGURATION



Photo: NACTO

SEPARATED BICYCLE LANES OR CYCLE TRACKS (CLASS 4)

Bike lanes provide dedicated space for bicyclists. Designs may include degrees of physical separation from parked vehicles and moving vehicles.

WHY WAS THIS CHOSEN FOR TAHOE?

- Streets through commercial areas in the Tahoe Region often lack bicycle infrastructure.
- By separating bicyclists from motor traffic, “protected” or physically separated bike lanes can offer a higher level of comfort and are attractive to a wider spectrum of the public.

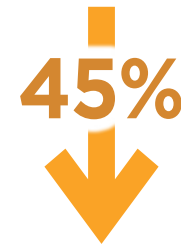
PLACEMENT & DESIGN CONSIDERATIONS

- Uses flexible posts and bollards, planters, curbs, or parked cars to separate automobiles from cyclists.
- Along streets with higher bicycle stress factors including high motor traffic volumes (9,000-30,000 ADT), higher traffic speeds (25+ mph), high incidence of double parking, and higher truck traffic (10% of total ADT).
- Separated bike lanes should be designed with snow removal operations in mind and close coordination with operations & maintenance staff.

CRASHES

APPLICABLE TYPES

**PEDESTRIANS
AND BIKES**



POTENTIAL
CRASH
REDUCTION*

APPROXIMATE COST

\$400K - 2M

PER MILE

EXPECTED DESIGN LIFE

20
YEARS

IMPLEMENTATION TIME FRAME



LONG

ADDITIONAL INFO

- [Caltrans Local Roadway Safety Manual](#)
- [FHWA Proven Safety Countermeasures](#)
- [Rural Design Guide](#)

* Caltrans, “Local Roadway Safety Manual,” Version 1.5, April 2020.
Crash reduction applies to traditional bike lane installation.

ROADWAY RECONFIGURATION

ROADWAY RECONFIGURATION

A roadway reconfiguration reduces the number of vehicle travel lanes and reallocates roadway space to help manage speeds and reduce crash risk for all users.

WHY WAS THIS CHOSEN FOR TAHOE?

- Unsafe speed is a contributing factor to many crashes in the Tahoe Region.
- Reduces crash risk in commercial and visitor corridors by slowing vehicle speeds, shortening pedestrian crossings, and designating space for bicyclists.

PLACEMENT & DESIGN CONSIDERATIONS

- Typically involves converting a four-lane undivided roadway to a three-lane roadway consisting of two through lanes and a center two-way left-turn lane.
- Often includes reducing lane widths.
- Allows reclaimed space to be allocated for turn lanes, bus lanes, pedestrian refuge islands, bike lanes, sidewalks, parking or landscaping.
- Per FHWA, typically implemented on a roadway with a current and future average daily traffic of 25,000 or less. Above 20,000 ADT, a feasibility study is recommended.



Photo: Kittelson & Associates, Inc.

CRASHES

APPLICABLE TYPES

ALL



POTENTIAL
CRASH
REDUCTION*

APPROXIMATE COST

\$500K - 2M

PER MILE**

EXPECTED DESIGN LIFE

20
YEARS

IMPLEMENTATION TIME FRAME



LONG

ADDITIONAL INFO

- [Caltrans Local Roadway Safety Manual](#)
- [FHWA Proven Safety Countermeasures](#)

* Caltrans, "Local Roadway Safety Manual," Version 1.5, April 2020.

**Depends on treatments included, if resurfacing road at the same time, and if drainage improvements are also included.

BUS PULL-OUT

Pull-out stops allow buses to move out of the bicycle lane and complete boarding at the curb.

WHY WAS THIS CHOSEN FOR TAHOE?

- In the Tahoe Region, there are few locations where buses can complete loading and unloading outside of travel lanes along existing and future transit routes.
- Allowing for buses to pull out of the travel lanes without blocking the bike lane improves conditions for all road users.

PLACEMENT & DESIGN CONSIDERATIONS

- Bus pull-outs are most useful where flow is a priority, in-lane stops would be problematic, or transit service includes long dwell times.
- Care is needed to manage conflicts on routes where bicyclists are present. Buses should be able to pull fully out of the vehicle travel lane and bicycle lane.
- In lane stops are preferred if there is insufficient space for a bus to fully pull out of the travel lane.



Photo: Kittelson & Associates, Inc.

CRASHES

APPLICABLE TYPES

ALL

N/A* POTENTIAL
CRASH
REDUCTION

APPROXIMATE COST

\$180
PER LINEAR FOOT

EXPECTED DESIGN LIFE

20
YEARS

IMPLEMENTATION TIME FRAME

● ● ○ MEDIUM

ADDITIONAL INFO

- [NACTO Transit Street Design Guide](#)

**Further studies are needed to determine crash reduction potential.*

BUS BOARDING ISLANDS



Photo: Kittelson & Associates, Inc.

Bus boarding islands are dedicated boarding locations separated from the sidewalk that enable buses to stop without crossing a bike lane, thereby reducing bus-bike conflicts.

WHY WAS THIS CHOSEN FOR TAHOE?

- In the Tahoe Region, mixed land use corridors serve the bus network and bike trips. This stop type increases safety by reducing bus-bike conflicts at bus stops.

PLACEMENT & DESIGN CONSIDERATIONS

- Consider existing and planned bike facilities to identify where islands help maintain separated bike lanes.
- Rider safety can be increased by adding space for passengers to wait.
- Suitable for high traffic pedestrian environments, highly contextual.

CRASHES

APPLICABLE TYPES

**PEDESTRIAN
AND BIKES**

N/A*

POTENTIAL
CRASH
REDUCTION

APPROXIMATE COST

\$220

PER LINEAR FOOT

EXPECTED DESIGN LIFE

20
YEARS

IMPLEMENTATION TIME FRAME



SHORT

ADDITIONAL INFO

- [NACTO Transit Street Design Guide](#)

**Further studies are needed to determine crash reduction potential.*

GATEWAY SIGN



Photo: Placer County

Treatment adds stylized signs along major arterials at city/town borders to clearly mark the transition into the town and help naturally slow motorists.

WHY WAS THIS CHOSEN FOR TAHOE?

- State roads in the Tahoe Region cross through multiple cities and towns; state roads are bordered with more-dense mixed land uses, and lower speeds are appropriate.
- Gateway signs can assist with wayfinding by alerting drivers that their destination is approaching.

PLACEMENT & DESIGN CONSIDERATIONS

- Consider combining with dynamic speed warning sign to reinforce for drivers the change in appropriate speed.
- Consider combining with other traffic-calming measures such as lane-narrowing, introduction of curbs (if absent), introduction of pedestrian-scale lighting, raised, landscaped median.

CRASHES

APPLICABLE TYPES

N/A

N/A*

POTENTIAL
CRASH
REDUCTION

APPROXIMATE COST

VARIES**

EXPECTED DESIGN LIFE

VARIES

IMPLEMENTATION TIME FRAME



MEDIUM

ADDITIONAL INFO

- [VDOT Traffic Calming Guide for Neighborhood Streets](#)

**Further studies are needed to determine crash reduction potential.*

***Gateway treatments can vary by location and type of configuration selected. Costs vary accordingly."*

APPENDIX B: FUNDING OPPORTUNITIES

To accelerate the Tahoe region's progress to zero fatalities and serious injuries, local entities need funding to implement safety projects. This section lists federal and state funding opportunities that eligible entities may apply for funding to implement countermeasures and projects to improve roadway safety. This list is meant to serve as a guide and is not intended to be exhaustive.

Program	Description	State or Federal Funding Agency
Safe Streets and Roads for All (SS4A)	Grant program for local planning and demonstration and/or implementation projects.	U.S. DOT
Highway Safety Improvement Program (HSIP)	The program's purpose is to achieve a significant reduction in traffic fatalities and serious injuries on all public roads, including non-State-owned roads and roads on tribal land. The HSIP requires a data-driven, strategic approach to improving highway safety on all public roads with a focus on performance.	Federal-aid program managed by Caltrans and NDOT as state HSIP
Surface Transportation Block Grant program (STBG)	Program to preserve and improve roadway safety and performance.	Federal Highway Administration (FHWA)
Rebuilding American Infrastructure with Sustainability and Equity (RAISE)	Program for road, rail, transit, and port projects that promise to achieve national objectives and have a significant local or regional impact by improving transportation infrastructure.	U.S. DOT
Reconnecting Communities and Neighborhoods (RCN)	Program to prioritize disadvantaged communities, improve access to daily needs, and foster equitable development by removing, retrofitting, or mitigating highways or other transportation facilities that currently create barriers to community connectivity, mobility, access, and economic development.	U.S. DOT
Transit-Oriented Development (TOD) Planning	Capital Investment grant program to assist efforts to focus growth around transit stations to create compact, mixed-used communities with easy access to jobs and services.	Federal Transit Administration (FTA)
Strengthening Mobility and Revolutionizing Transportation (SMART)	Purpose-driven innovation to build data and technology capacity and expertise for State, local, and Tribal governments.	U.S. DOT
Active Transportation Program (ATP)	Funds projects that encourage increased mode share for walking and bicycling, improve mobility and safety for non-motorized users, enhance public health, and decrease greenhouse gas emissions.	California Transportation Commission (CTC)

Transportation Alternatives Set-Aside Program (TAP)	Funds smaller-scale, community-based transportation projects that improve safety, expand travel choices, and enhance the transportation experience.	Nevada Department of Transportation (NDOT)T
Local Partnership Program (LPP)	Funds transportation improvements related to aging infrastructure, road conditions, active transportation, transit, and rail, and those that provide health and safety benefits.	California Transportation Commission (CTC) and Caltrans
Solutions for Congested Corridors Program (SCCP)	Projects that implement specific transportation performance improvements and are already identified in a regional transportation plan (RTP) and are part of a comprehensive corridor plan. Eligible improvements include adding new or improving existing transit and rail infrastructure, transit hubs, first/last-mile connections to transit hubs, closing gaps in street and active transportation networks, safety improvements, innovative technologies, and pedestrian and bicycle facilities	California Transportation Commission (CTC) and Caltrans
Sustainable Transportation Planning (STP)	Planning efforts that assist vulnerable road user safety, including Safe Routes to School plans.	Caltrans
Office of Traffic Safety (OTS) Grants	Projects aiming to improve traffic safety by addressing one of the eligible program areas and supported by data.	California OTS and Nevada State Police OTS
Federal Lands Access Program (FLAP)	The Access Program supplements State and local resources for public roads, transit systems, and other transportation facilities, with an emphasis on high-use recreation sites and economic generators. Eligible projects must provide access to or be adjacent to federal lands.	Office of Federal Lands. California and Nevada competitive processes.
Multimodal Project Discretionary Grant (MPDG)	MPDG grant program consists of three grants: INFRA, Rural, and Mega. Competitively funds surface transportation infrastructure projects with significant national or regional impact, or to improve and expand the surface transportation infrastructure in rural areas.	U.S. DOT

APPENDIX C: DRAFT VISION ZERO RESOLUTION

TAHOE REGIONAL PLANNING AGENCY
TRPA RESOLUTION NO. 2024-03

RESOLUTION IN SUPPORT OF THE GOAL OF ACHIEVING ZERO FATALITIES AND SERIOUS INJURIES ON
ROADWAYS IN THE TAHOE BASIN BY 2050 AND ENDORSEMENT OF VISION ZERO TO
ACHIEVE THIS GOAL.

WHEREAS, according to data from the National Highway Traffic Safety Administration, each year approximately 40,000 people are killed in traffic collisions in the United States; and

WHEREAS, from 2013 to 2021, 41 people died and 183 suffered serious injuries on roads in the Tahoe Region; and

WHEREAS, a basic tenet of Vision Zero is that fatal and serious crashes are not inevitable, and death and serious injury are not an acceptable cost for using our public roadway system; and

WHEREAS, the Vision Zero Strategy provides a framework for reducing traffic deaths and serious injuries through a data-driven approach; and

WHEREAS, TRPA is dedicated to work with local and state jurisdictions to implement countermeasures and projects that aim to significantly reduce deaths and serious injuries on Tahoe roads; and

WHEREAS, Vision Zero supports the Regional Transportation Plan/Sustainable Communities Strategy goal of Safety; and

WHEREAS, a commitment to Vision Zero considers and supports equity, as low-income communities and communities of color carry a disproportionate burden of traffic-related injuries and fatalities in the U.S.; and

WHEREAS, the Tahoe Basin joins other regions, counties, and cities across the Nation in a commitment to Vision Zero, an evidence-backed approach with demonstrated success; and

WHEREAS, TRPA joins the Nevada Department of Transportation in their commitment to zero fatalities by 2050; and

WHEREAS, TRPA joins the California Department of Transportation in their commitment to zero fatalities and serious injuries by 2050;

NOW, THEREFORE, BE IT RESOLVED that the Governing Board of the Tahoe Regional Planning Agency adopts a goal of eliminating traffic deaths and serious injuries by 2050 and endorses the Vision Zero Strategy as an approach to achieving this goal.

PASSED and ADOPTED by the Governing Board of the Tahoe Regional Planning Agency this 28th day of February, 2024, by the following vote:

Ayes: Ms. Aldean, Ms. Bowman/Mr. Diciara (for Mr. Aguilar), Mr. Bass, Ms. Conrad-Saydah, Ms. Faustinos, Ms. Gustafson, Ms. Hill, Mr. Hoenigman, Ms. Laine, Ms. Leumer, Mr. Settelmeyer, Ms. Williamson

Absent: Ms. Diss, Mr. Rice

A handwritten signature in blue ink, reading "Cindy Gustafson", with a long horizontal flourish extending to the right.

Cindy Gustafson, Chair
Tahoe Regional Planning Agency
Governing Board

APPENDIX C: COMMUNITY OUTREACH SURVEY

Tell Us About Transportation Safety in Tahoe

The first 5 questions apply to transportation in the Tahoe Region as a whole:

What is your primary mode of transportation in a typical week?

- A. Walking/rolling
- B. Bicycle
- C. Transit
- D. Vehicle
- E. Motorcycle
- F. Shared Mobility/E-scooters
- G. Using a special transportation service, such as one for seniors or persons with disabilities

Please circle how you feel about the following statement:

The Lake Tahoe Region is a safe place for all road users—motorists, bicyclists, and pedestrians—to travel.

Strongly Agree

Agree

Neutral

Disagree

Strongly Disagree

Please rate how you feel travelling by each mode of transportation:

[illegible]

Which type of bicyclist do you most closely identify with?

- A. Strong and Fearless: People willing to bicycle with limited or no bicycle-specific infrastructure
- B. Enthused and Confident: People willing to bicycle if some bicycle-specific infrastructure is in place
- C. Interested but Concerned: People willing to bicycle if high-quality bicycle infrastructure is in place
- D. No Way, No How: People unwilling to bicycle but may if high-quality bicycle infrastructure is in place

Vision Zero is a strategy to eliminate all traffic fatalities and severe injuries, while increasing safe, healthy, equitable mobility for all. Have you heard of Vision Zero?

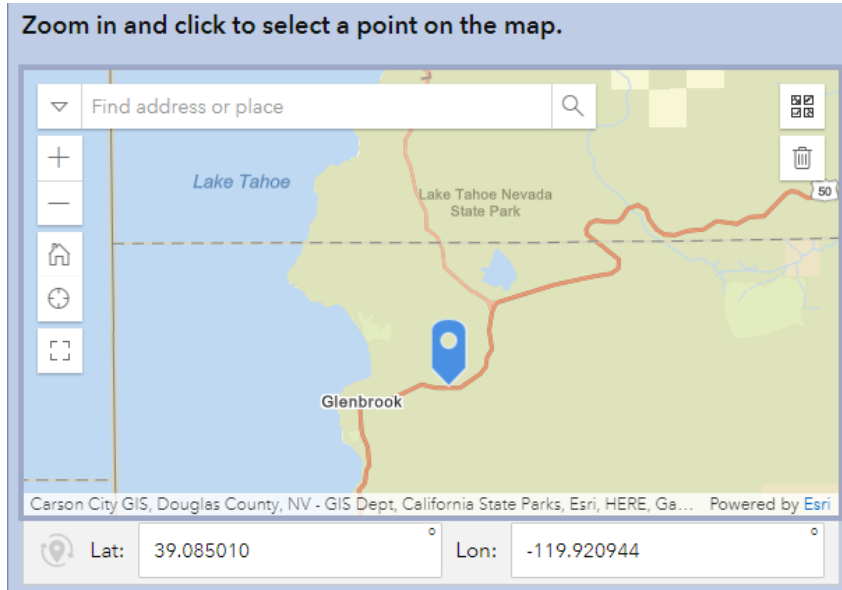
- A. Yes
- B. No

What are your biggest safety concerns while travelling in Tahoe? Select the top 3:

- A. Speeding
 - B. Distracted driving
 - C. Driving under the influence
 - D. Not enough lighting
 - E. Not enough crosswalks
 - F. Not enough bicycle lanes or bicycle paths
 - G. Poorly maintained bicycle routes (snow, debris or potholes)
 - H. Winter weather conditions
 - I. Drivers not yielding to people in crosswalks
 - J. Poor sightline visibility (the length of roadway visible to a driver, i.e. at driveways, bicycle crossings, roundabouts)
 - K. Other:
-

The following 5 questions apply to a specific location in the Tahoe Region. This could be a street, intersection, roundabout, bicycle lane, etc.

Which location would you like to provide feedback on? (You may comment on multiple locations.)



For this location, what mode of transportation would you like to give feedback on?

- A. Bicycle
- B. Walk
- C. Assisted Mobility
- D. Roll (scooter, skateboard, one-wheel)
- E. Vehicle
- F. Transit

How safe do you feel travelling at this location? (Circle below)

Safe or low-stress

Neutral

Unsafe or high-stress

If you selected unsafe, have you had a near miss at this location? A near miss is a narrowly avoided collision with another party.

- A. Yes
- B. No

Additional Comments

Please Tell Us A Little About Yourself

Which of the following best describes your residency in the Lake Tahoe Region?

- A. Full-time resident
- B. Seasonal resident
- C. Commuter (live outside the basin, but commute to the basin to work)
- D. Visitor

What's the zip code of your primary residence? _____

What is your age?

- A. Under 18
- B. 19-24
- C. 25-34
- D. 35-44
- E. 45-54
- F. 55-65
- G. 65+

What gender do you identify as?

- A. Female
- B. Male
- C. Non-binary
- D. Transgender
- E. Prefer not to say
- F. Other _____

How many people live in your household (as a family unit)?

- A. 1 person
- B. 2 people
- C. 3 people
- D. 4 people
- E. 5 people
- F. 6 or more people

What is your total family income?

- A. Under \$20,000
- B. \$20,000 to \$30,000
- C. \$31,000 to \$40,000
- D. \$41,000 to \$50,000
- E. \$51,000 to \$75,000
- F. \$76,000 to \$100,000
- G. Above \$100,000

REFERENCES

Albee, M., & Bobitz, P. (2021). *Making Our Roads Safer | One Countermeasure at a Time*. Federal Highway Administration Office of Safety.

Alta Planning + Design. *Small Town and Rural Design Guide, Facilities for Walking and Biking*.

<https://ruraldesignguide.com/visually-separated/bike-lane>

American Public Transportation Association. (n.d.) *Public Transportation Facts*.

<https://www.apta.com/news-publications/public-transportation-facts/>

Avelar et al. (2020). *Developing Crash Modification Factors for Variable Speed Limit*. Office of Safety Research and Development Federal Highway Administration.

Bliss, Laura. (2021). *The Car Crashes that Go Undetected*. Bloomberg.

<https://www.bloomberg.com/news/articles/2021-07-15/how-many-traffic-crashes-are-going-unreported>

California Department of Motor Vehicles. (n.d.). *California Driver's Handbook, Section 9: Alcohol and Drugs*.

California Department of Transportation. (2014). *California Manual on Uniform Traffic Control Devices, Revision 7*.

California Department of Transportation. (2020). *Caltrans Local Roadway Safety Manual, Version 1.5*.

California Department of Transportation. (2023). *Draft Vulnerable Road Users (VRU) Safety Assessment*.

Connecticut Transportation Institute. (2019). *Retroreflective Backplates — A Proven Safety Countermeasure*. Training and Technical Assistance Center.

Center for Disease Control and Prevention. (2023). *Transportation Safety*.

<https://www.cdc.gov/transportationsafety/index.html#:~:text=Motor%20vehicle%20crashes%20are%20a,injuries%20and%20deaths%20are%20preventable>.

Design Workshop. (2020). *Main Street Management Plan*. Prepared for the TTD, TMPO, City of South Lake Tahoe and Douglas County.

Fehrs & Peers. (2019). *Pedestrian Safety Countermeasures Toolbox*. Prepared for the California Department of Transportation.

Federal Highway Administration. (n.d.). *Traffic Calming 23. Curb Extensions*.

<https://safety.fhwa.dot.gov/saferjourney1/Library/countermeasures/23.htm>

Federal Highway Administration. (2009). *Manual on Uniform Traffic Control Devices*.

Federal Highway Administration. (2023). *Manual on Uniform Traffic Control Devices*.

Federal Highway Administration. (2016). *Small Town and Rural Multimodal Networks*.

Federal Highway Administration. (2017). *Rumble Strips and Rumble Stripes*.

https://safety.fhwa.dot.gov/roadway_dept/pavement/rumble_strips/bike_fs/

Federal Highway Administration. *Roundabouts*. PEDSAFE.

http://www.pedbikesafe.org/pedsafe/countermeasures_detail.cfm?CM_NUM=25

Federal Highway Administration. (2023). *Zero Deaths and Safe System*.

<https://highways.dot.gov/safety/zero-deaths>

Gross, Andrew. (2021). *Pandemic Pause: Americans Cut Driving Nearly In Half In Early Stage of COVID Crisis*. AAA Foundation for Traffic Safety. <https://newsroom.aaa.com/2021/07/travel-before-and-during-covid-july-2021/>

Insurance Institute for Highway Safety. (2023). *Roundabouts*. <https://www.iihs.org/topics/roundabouts>

Kimley-Horn. (2022). *El Dorado County Local Roadway Safety Plan*. Prepared for County of El Dorado Department of Transportation.

National Conference of State Legislatures. (2023). *Drugged Driving | Marijuana-Impaired Driving*.

Nevada Department of Motor Vehicles. (2018). *DUI Laws*. <https://dmv.nv.gov/pdf/forms/qtdui.pdf>

Nevada Department of Transportation. (2021). *Nevada Strategic Highway Safety Plan*.

Nevada Department of Transportation. *Using Roundabouts*.

<https://www.dot.nv.gov/safety/roadway-safety-improvements/roundabouts/using-roundabouts>

National Highway Traffic Safety Administration. (2015). *National Telephone Survey of Reported and Unreported Motor Crashes*.

Oregon Department of Transportation. (2020). *Oregon Analysis Procedural Manual, Chapter 14*.

Oregon Department of Transportation. (n.d.) Speed Zoning FAQ.

Placer County. (2020) *Resort Triangle Transportation Plan*.

Schultheiss, B., Goodman, D., Blackburn, L., Wood, A., Reed, D., & Elbech, M. (2019). *Bikeway Selection Guide*. Office of Safety Federal Highway Administration.

Washington State Department of Transportation. (2022). *Queue Warnings*.

<https://tsmowa.org/category/intelligent-transportation-systems/queue-warnings>

Washoe County. (2023). *Washoe County Tahoe Transportation Plan*.

Tahoe Regional Planning Agency. (2019). *Lake Tahoe Region Safety Strategy*.

Ullman, G., Schroeder, J., & Gopalakrishna, B. (2014). *Use of Technology and Data for Effective Work Zone Management: Work Zone ITS Implementation Guide*. Federal Highway Administration.

United States Census Bureau. (2020).

Vision Zero Network. (2023). *What is Vision Zero?* <https://visionzeronetwork.org/about/what-is-vision-zero/>