

U.S. Highway 50 Road Safety Audit **South Tahoe "Y" to Trout Creek, City of South Lake Tahoe, CA** **Final Report**

January 29, 2018



Road Safety Audit Team:

1. Ray Jarvis, City of South Lake Tahoe Public Works Director
2. Jim Marino, City of South Lake Tahoe Assistant Director of Public Works
3. Jeff Gartner, California Highway Patrol - South Lake Tahoe, Officer
4. Clark Peri, Caltrans, District 3, Project Manager
5. Scott Waksdal, Caltrans, District 3, Traffic Operations
6. Mikaela Hiatt, Tahoe regional Planning Agency, Transportation Intern
7. Steve Pyburn, FHWA CA division Office, Safety Engineer
8. Craig Allred, FHWA, Resource Center, Safety and Design Technical Service Team, RSA Facilitator
9. Hilary Isebrands, FHWA, Resource Center, Safety and Design Technical Service Team, Intersection and Pedestrian Specialist
10. Brooke Struve, FHWA, Resource Center, Safety and Design Technical Service Team, Bicycle Specialist

Additional Stakeholder Input:

1. Morgan Beryl, Tahoe Regional Planning Agency, Senior Transportation Planner
2. Transit Operators, Tahoe Transportation District
3. George Fink, Tahoe Transportation District, Transit System Program Manager
4. Tara Styer, Tahoe Transportation District, Operations Manager
5. Steve Teshara, Chair, South Shore Transportation Management Association
6. Peter Fink, Member, City of South Lake Tahoe Parks and Recreation
7. Brian Uhler, Chief, City of South Lake Tahoe Police Department
8. David Stevenson, Lieutenant, City of South Lake Tahoe Police Department
9. Gianna Leavers, Community Mobility Group
10. John Hitchcock, City of South Lake Tahoe, Planning Manager

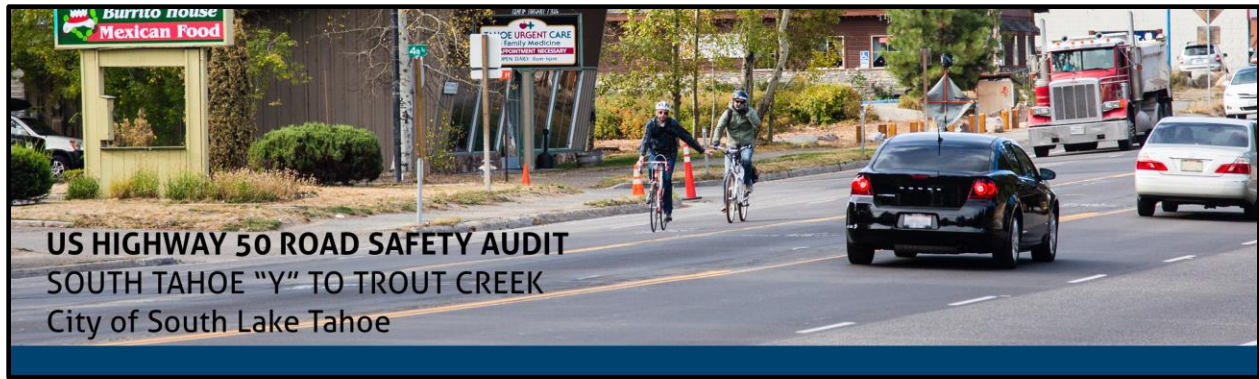
Table of Contents:

Page Number

| | |
|---|----|
| Executive Summary - - - - - | 1 |
| Safety Data - - - - - | 7 |
| Enhanced Intersection Design - - - - - | 11 |
| Infrastructure Improvements for Bicyclist Safety - - - - - | 16 |
| Pavement Marking Durability - - - - - | 20 |
| Mid-Block Crossings - - - - - | 23 |
| Pedestrian and Roadway Lighting - - - - - | 28 |
| Transit Stop Locations Relative to Pedestrian Crossings - - - - - | 32 |
| Transit Stop Design - - - - - | 35 |
| Speed Management - - - - - | 39 |
| Winter Maintenance and Snow Removal Plan - - - - - | 42 |
| Pedestrian and Bicyclist Accommodation in Work Zones - - - - - | 45 |
| Education and Enforcement - - - - - | 48 |

Disclaimer:

Federal law affords evidentiary and discovery protections that assist State and local highway agencies in keeping data and reports compiled or collected pursuant to various Federal safety improvement programs from being used in tort liability actions. The Highway Safety Act of 1973 was enacted to improve the safety of our Nation's highways by encouraging closer Federal and State cooperation with respect to road safety improvement projects. In 2003, the U.S. Supreme Court upheld the Constitutionality of 23 U.S.C. § 409 ("Section 409"), indicating that it "protects all reports, surveys, schedules, lists, or data actually compiled or collected for § 152 purposes of identifying, evaluating, or planning the safety enhancement of potential accident sites, hazardous roadway conditions, or railway.



EXECUTIVE SUMMARY

January 29, 2018



U.S. Highway 50 runs directly through the City of South Lake Tahoe, where it functions as both a state highway serving traffic from Nevada and California as well as the city's main street. This important roadway serves residents, visitors, and commuters by connecting State Route 89 from the West Shore to the California and Nevada state line.

In the 1990s, Caltrans scoped its first water quality improvement project for the U.S. Highway 50 corridor in South Lake Tahoe. The goal was to reduce the amount of fine sediment reaching Lake Tahoe. As the project moved through approval processes, its scope and goals grew from simply improving water quality to incorporating other important community and transportation benefits such as sidewalks, intersection reconfigurations, and bike lanes. During the many years of project scoping and implementation, community values, best practices, and agency missions have evolved to embrace the concept of Complete Streets¹. The Highway 50 reconstruction project from Trout Creek to Ski Run, completed in 2013, illustrates how the project evolved to incorporate not only water quality improvements, but also bike lanes, sidewalks, and pedestrian lighting that resulted from multi-agency agreements and funding mechanisms.

Numerous complexities in this Highway 50 corridor have created new challenges and needs for the South Lake Tahoe community, which has about 23,000 full-time local residents. These complexities include fluctuating seasonal traffic volumes that can swell to as high as approximately 30,000 AADT in some areas during times of peak visitation, varied land uses and highway access points, and increasing pedestrian and bicycle demand with missing connectivity in some areas. An estimated 10 million vehicles enter the Lake Tahoe Region each year.



These needs, challenges, and solutions are identified in the 2016 Linking Tahoe: Active Transportation Plan, the 2017 Linking Tahoe: Regional Transportation Plan, and the city's local area plans and general plan. The final multi-million-dollar Highway 50 reconstruction project from Trout Creek to the South Tahoe "Y" in the city starting in 2017 prompted conversations between the Tahoe Regional Planning Agency, Caltrans, and the City of South Lake Tahoe. Ultimately, these agencies requested a pedestrian and bicycle road safety audit (RSA) and the audit was completed with help from the Federal

Highway Administration (FHWA). Caltrans expressed a willingness to consider incorporating reasonable modifications to its U.S. Highway 50 Trout Creek to "Y" project based on recommendations and best practices, with the understanding that some constraints exist with the project already underway. Additionally, there was an urgency to mitigate known risks that are not being addressed in the current construction project and to respond to community desires.

Road Safety Audit Overview:

According to the Federal Highway Administration's (FHWA) Road Safety Audit Guidelines², a road safety audit (RSA) is a formal safety examination of a future roadway plan or project or an in-service

¹ Caltrans Complete Street Policy: <http://www.dot.ca.gov/transplanning/ocp/complete-streets.html>

A complete street is a transportation facility that is planned, designed, operated, and maintained to provide safe mobility for all users, including bicyclists, pedestrians, transit vehicles, truckers, and motorists, appropriate to the function and context of the facility. Every complete street looks different, according to its context, community preferences, the types of road users, and their needs.

TRPA also has a complete street policy, please see 2016 Active Transportation Plan.

² FHWA, <https://safety.fhwa.dot.gov/rsa/guidelines/>

facility and is conducted by an independent, experienced, and multidisciplinary RSA team.³ The primary focus of an RSA is safety while working within the context of mobility, access, surrounding land use, user demand, and aesthetics. RSAs identify potential safety issues affecting all road users under all conditions and suggest solutions for consideration by the project design team and responsible agencies. In addition to using an RSA as a tool to assess and improve safety performance of facilities, public agencies may wish to conduct RSAs oriented to assess or address safety issues related to specific user groups such as pedestrians and bicyclists. RSA's can be performed as both a proactive and reactive approach to assessing and improving roadway safety.

The RSA team included representatives from the U.S. Department of Transportation's Federal Highway Administration, California Highway Patrol (CHP), Caltrans, City of South Lake Tahoe (public works, police), Tahoe Regional Planning Agency (TRPA), and Tahoe Transportation District (TTD). The team also met with advocacy groups, including the Lake Tahoe Bicycle Coalition, South Shore Transportation Management Association, and the Community Mobility Group. The team conducted the RSA July 25 to July 27 2017 and it included field observations both during the day and night.



Goals and Observations

The goals for the RSA were to reflect the following during discussions, field reviews, and as recommendations and solutions:

- ✓ Balance need for pedestrian and bicyclist safety and access with need for vehicular movements
- ✓ Assess value and need for speed management strategies
- ✓ Coordinate and leverage current and planned projects on U.S. Highway 50
- ✓ Enhance pedestrian and bicyclist crossings through implementation of proven strategies and countermeasures
- ✓ Enhance bicycle safety along highway
- ✓ Balance recommendations with maintenance needs

The RSA team found that there was evidence of multi-agency coordination and support for projects as well as a desire to improve roadway infrastructure with current projects. The opportunities for improvement were evident even with missing and inconsistent crash and safety data, and the varying accessibility and sharing of safety data. Even without robust safety data, it was clear to the RSA team that with three pedestrian fatalities between the "Y" and Trout Creek between 2011 and 2016, and numerous reported pedestrian and bicycle injury crashes, that this corridor is a high-risk roadway for vulnerable roadway users. The safety data, the vehicular volume, lack of lighting, multi-modal use, and number of access point, such as driveways, are all safety risk factors for an urban corridor. It is also evident that there is a struggle with U.S. Highway 50 serving as both a state

³ Federal law affords evidentiary and discovery protections that assist State and local highway agencies in keeping data and reports compiled or collected pursuant to various Federal safety improvement programs from being used in tort liability actions. The Highway Safety Act of 1973 was enacted to improve the safety of our Nation's highways by encouraging closer Federal and State cooperation with respect to road safety improvement projects. In 2003, the U.S. Supreme Court upheld the Constitutionality of 23 U.S.C. § 409 ("Section 409"), indicating that it "protects all reports, surveys, schedules, lists, or data actually compiled or collected for § 152 purposes of identifying, evaluating, or planning the safety enhancement of potential accident sites, hazardous roadway conditions, or railway.

highway and a main street in South Lake Tahoe. High speed vehicles are incompatible with high pedestrian and bicycle volumes along the corridor.

RSA Recommendations and Solutions

The RSA team identified numerous safety emphasis areas to address in its discussions and field reviews. The table below summarizes those emphasis areas, the recommendations for each and potential solutions to the issues. The full report is divided into sections by emphasis area and provides detailed and in-depth assessments of the recommendations and specific solutions. Some recommendations are short term and could be made through change orders to the existing project. Some recommendations are longer term and require additional analysis and funding. Additionally, some of the recommendations may reflect previous considerations made by Caltrans, but ultimately not included in the project due to funding constraints and preceding regional policies, such as the requirement to mitigate coverage for active transportation infrastructure. This requirement was waived as part of the 2012 Regional Plan Update, which now provides an exemption for coverage mitigation for active transportation infrastructure.

| Emphasis Areas | Recommendation | Solutions |
|---|---|---|
| 1. Safety Data | Improve quality and timeliness of safety data particularly for pedestrian and bicyclists. | <ul style="list-style-type: none"> Support "Lake Tahoe Safety Plan" Collect surrogate safety data for pedestrians/bicyclists Conduct pedestrian and bicyclists counts to assess spot improvement needs |
| 2. Enhanced Intersection Design | Provide high visibility pedestrian crossings for all movements at all signalized intersections. | <ul style="list-style-type: none"> Install high visibility crosswalk markings for all movements Install pedestrian lighting at all crossings Coordinated traffic signals for the desired target speed (35 mph) between signalized intersections |
| 3. Infrastructure Improvements for Bicyclists Safety | Provide the maximum width possible for bicycle lanes where possible and enhance bicycle pavement markings for longevity and increased visibility. | <ul style="list-style-type: none"> Widen Class II bike lanes in areas where the roadway width allows taking advantage of bridge areas and TWLTL⁴ in areas without access points Install helmeted bicycle symbol instead of words and increase number of locations to account for numerous access points Improve bike lane marking near intersections Improve bicycle route connectivity along and across U.S. Highway 50 |
| 4. Pavement Marking Durability | Install more durable pavement markings to account for the harsh winter and maintenance schedule | <ul style="list-style-type: none"> Install recessed pavement markings for bicycle facilities Improve the frequency and timing of the pavement marking to coincide with peak bicycle use |
| 5. Mid-Block Crossings <i>Grocery Outlet/ Motel 6 & Town and Country Shopping Area (Whiskey Dick's/Sunray Tahoe Hotel)</i> | Study the feasibility of enhanced mid-block crossings in at least 2 locations with high pedestrian crossings and identified safety risks. | <ul style="list-style-type: none"> Install pedestrian refuge islands, enhanced pavement markings and Pedestrian Hybrid Beacons near Grocery Outlet and Whiskey Dicks/Sunray Tahoe Hotel |

⁴ Two Way Left Turn Lane

| Emphasis Areas | Recommendation | Solutions |
|--|--|--|
| 6. Pedestrian and Roadway Lighting | Install and enhance roadway, intersection and pedestrian lighting | <ul style="list-style-type: none"> Adjust or enhance signalized intersection lighting to provide pedestrian lighting for crosswalks Install roadway lighting along the corridor Assess the possibility of oversized conduit costs and type of the traffic controller cabinets in the project to offset funding to install additional lighting |
| 7. Transit Stop Locations Relative to Pedestrian Crossings | Adjust bus stop locations based on user needs and desire lines between origins and destinations | <ul style="list-style-type: none"> Consolidate bus stops near Grocery Outlet to reduce from 4 to 2 stops – one in each direction |
| 8. Transit Stop Design | Improve bus stop pull-out configurations and pavement markings in areas where bus stops conflict with bike lanes | <ul style="list-style-type: none"> Remove bus pull-outs where there is not adequate width for vehicles to pass in the curbside lane and remain as in-lane operation Include bike lane symbols before and after lane pull-out tapers |
| 9. Speed Management | Engage in a speed management plan that incorporates a “target speed” as its basis. This includes consistent operating, design and posted speeds. | <ul style="list-style-type: none"> Conduct a speed study along the corridor using noteworthy practices that consider roadway users and context Prepare a speed management plan for CSLT |
| 10. Winter Maintenance and Snow Removal Plan | Review the Caltrans snow removal plan to consider operations based on increase in pedestrian and bicycle users along U.S. Highway 50 | <ul style="list-style-type: none"> Develop maintenance agreement between CSLT and Caltrans Consider a pre-treatment plan for sidewalks before storms Encourage property owners to keep new sidewalk clear of snow in the winter through targeted outreach |
| 11. Pedestrians and Bicyclists Accommodation in Work Zones | Update guidance and construction plans with best practices for pedestrian and bicycle use and accessibility | <ul style="list-style-type: none"> Improve pedestrian accommodation and accessibility in the work zone Improve bicycle accommodation in the work zone |
| 12. Education and Enforcement | Enhance current education efforts and consider targeted enforcement campaigns | <ul style="list-style-type: none"> Increase bike helmet use in CSLT Improve bicycle wayfinding Develop enforcement campaigns & advertised sting operations |

Immediate Next Steps to Implement Recommendations

To take advantage of the opportunity to advance some of the RSA recommendations into the active U.S. Highway 50 construction projects from the “Y” to Trout Creek, some immediate next steps are suggested:

1. Caltrans, City of South Lake Tahoe, CHP, TRPA, and TTD decision makers should convene a meeting to discuss the RSA recommendations most relevant for consideration of a contract change order, including but not limited to bike lane markings, crosswalk markings, intersection

lighting for pedestrians, bus stop pull out design, and accessibility for pedestrians and bicyclists during construction.

2. Initiate engineering studies for mid-block crossings (Grocery Outlet and Whiskey Dicks) where safety issues have been documented.
3. Develop a speed management plan in advance of the speed study that will take place after project completion. The plan should use the best practice of designing for “target speeds” and use inputs that are representative of the users and context of the roadway.
4. The city should develop an agreement with Caltrans about developing a memorandum of understanding for maintenance procedures and operations of pavement marking, snow plowing, sweeping, etc. that are mutually agreeable for both agencies and in the best interest of the traveling public.
5. City staff and police should work with TRPA, the Lake Tahoe Bicycle Coalition, and CHP to launch an education and enforcement campaign in spring 2018. The campaign should include bicycle safety advertisements and enforcement around helmet use, riding with traffic, and nighttime visibility and should aim to reach businesses and the South Lake Tahoe community including Spanish speaking residents and visitors.
6. Participate in the active “Lake Tahoe Safety Plan” to implement recommendations to improve safety data for the Region.

Possible Funding Sources:

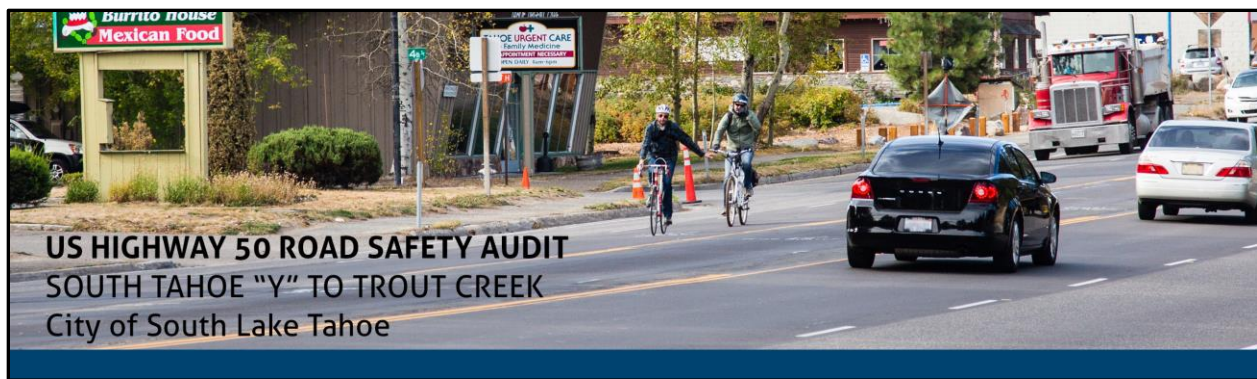
A variety of funding sources are available to implement many of these recommendations. Specific funding sources by type of improvement are noted in each section. Below is a list of funding sources and links to more information.

- FHWA Highway Safety Improvement Program funds distributed through Caltrans: <http://www.dot.ca.gov/hq/LocalPrograms/hsip.html>
- California Active Transportation Program funds distributed through Caltrans and the California Transportation Commission as well as through TRPA: <http://www.dot.ca.gov/hq/LocalPrograms/atp/>
- State Highway Safety Programs (Section 402): <https://safety.fhwa.dot.gov/legislationandpolicy/policy/section402/>
- FHWA Accelerated Innovation Deployment (AID) Demonstration: <https://www.fhwa.dot.gov/innovation/grants/>
- California Senate Bill 1 Funding: <http://rebuildingca.ca.gov/funding.html>

Conclusion

The RSA team’s recommendations should be considered by Caltrans as it completes Highway 50 projects between Winnemucca and Lodi and Lodi and Trout Creek in 2018 and 2019. Caltrans and the City of South Lake Tahoe should continue to look for opportunities to enhance safety along U.S. Highway 50 for all users taking advantage of policies and funding that support safe facilities to enhance and encourage an active community that is a walking and biking destination for resident and visitors.





SAFETY DATA

Issue Statement:

Accurate crash and roadway data is critical to understand, diagnose, and solve roadway safety issues. If only some crashes are documented and only a portion of the safety story told, it becomes a barrier to public agencies pursuing safety funding and to proactively address roadway safety concerns. The under-reporting of pedestrian and bicycle crashes also creates a gap in both identifying problem areas and the potential solutions to increase safety and awareness for all roadway users. In many cases this gap is a result of the crash reporting criteria that has been established in California. Additionally, if law enforcement agencies are reporting crashes differently, such as using varied abbreviations for street names and issue categorizing, it can also leave a gap in documentation and misinformation within the state reporting system.

Coeur d'Alene man identified as pedestrian killed in South Lake Tahoe accident

Submitted by paula on Tue, 12/13/2016 - 7:55pm



Reported in South Tahoe Now, Fatality December 2016, still not included in SWITRS

A Coeur d'Alene, Idaho man has been identified as the man killed while crossing Highway 50 on Saturday night in South Lake Tahoe. According to KREM-TV, 32-year-old Robert Parks was the victim. According to the television report, Parks' family described him as an outdoorsman, had started to hike the Pacific Crest Trail earlier this year, and that he had stopped in South Lake Tahoe. On December 10, San Jose resident Peng Shao was driving westbound on Highway 50 near the Town and Country Center when he struck Parks who was crossing the street outside of a crosswalk just after 11:00 p.m. There was a marked crosswalk with traffic light 100 yards to the west of where Parks was hit.

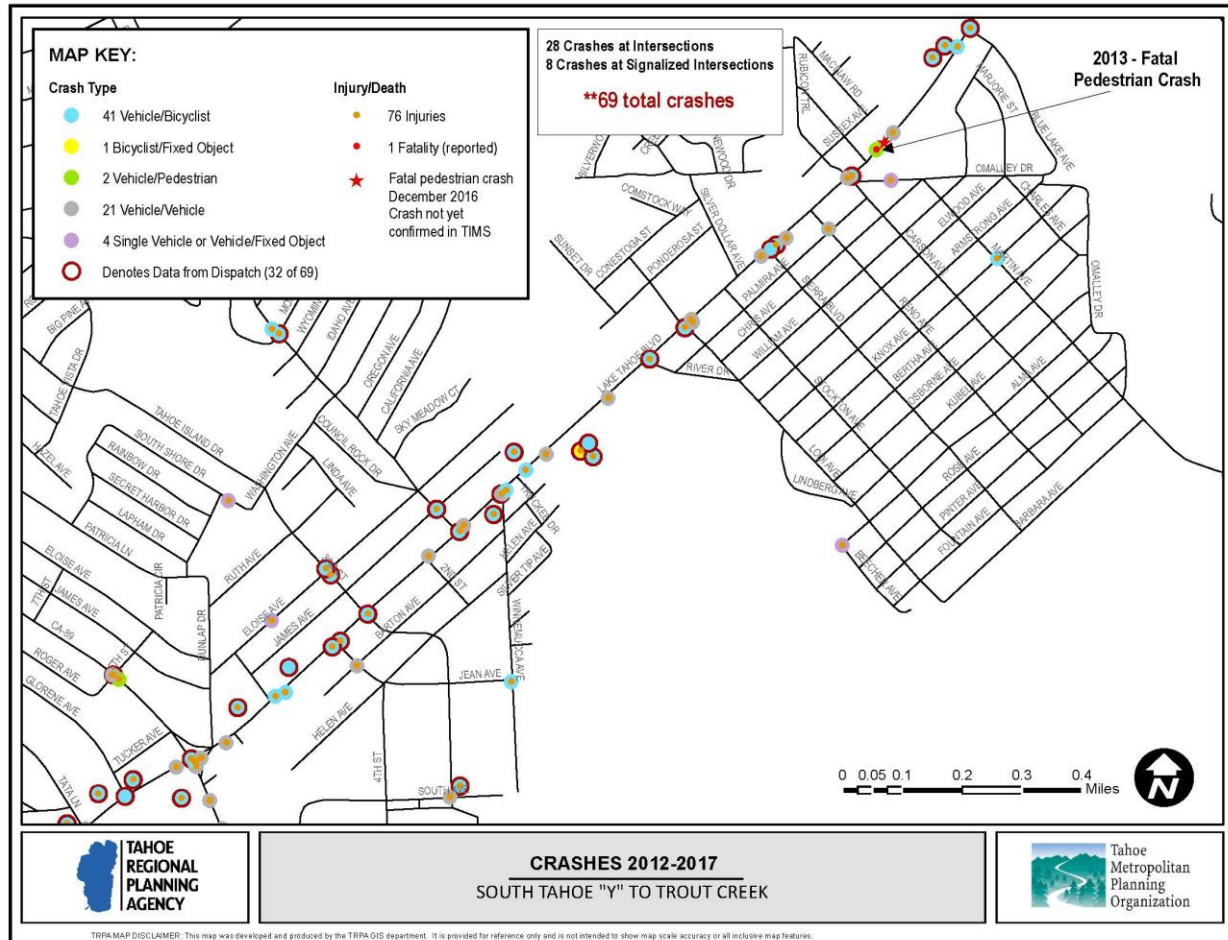
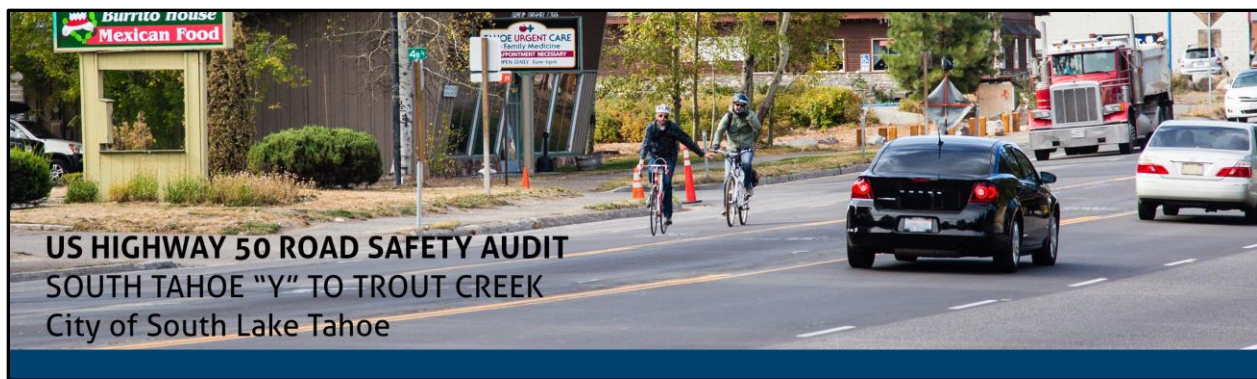
In the Lake Tahoe Region, it has been found that reported and documented crashes are inconsistent across agencies. The number of crashes that can be found in the state database (SWITRS) is different than California Highway Patrol's (CHP) records, and inconsistent with the CSLT computer aided dispatch (CAD) reports from 911 calls, and inconsistent with Barton Hospital records. More specifically, from west of the South Tahoe "Y" to Trout Creek, it was found that in CAD/911 calls from 2013 to 2016, 31 vehicle/bicycle crashes were identified with 25 of those being injury crashes. Over that same time period, only eight bicycle crash reports were documented in SWITRS. Additionally, one pedestrian fatality along this stretch of U.S. Highway 50 in December 2016 has not yet been documented in SWITRS, most likely due to lag time in updated information in the statewide database system. The map illustrates the difference in crashes reported from the CAD system and SWITRS. The tables illustrate the difference in crash reports from SWITRS, CAD, and documentation by area code obtained from Barton Hospital.

PEDESTRIAN INCIDENTS (2013 – 2016)

| Year | Barton Hospital Pedestrian Incidents | SWITRS/CAD Pedestrian Incidents | Non-Reported Pedestrian Incidents |
|--------------|--------------------------------------|---------------------------------|-----------------------------------|
| 2013 | 8 | 4 | 4 |
| 2014 | 10 | 3 | 7 |
| 2015 | 19 | 4 | 15 |
| 2016 | 16 | 7 | 9 |
| TOTAL | 53 | 18 | 35 |

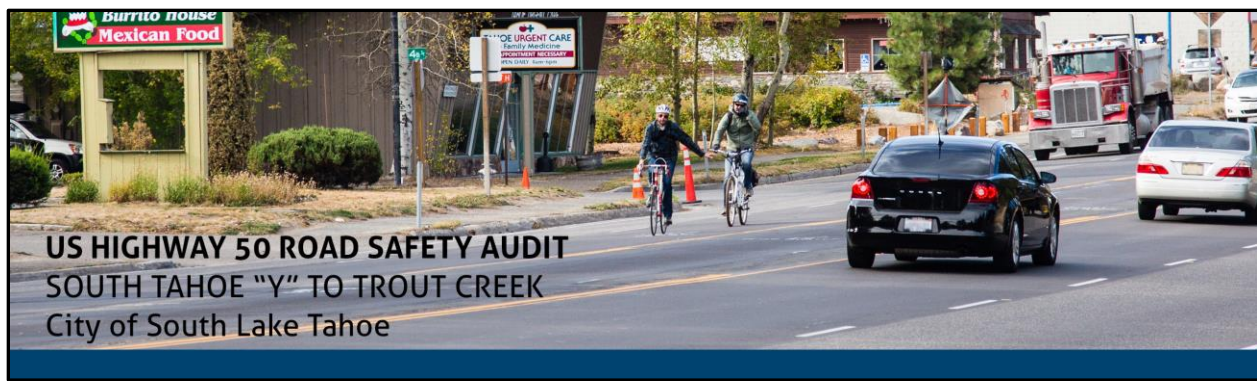
BICYCLE INCIDENTS (2013 – 2016)

| Year | Barton Hospital Bicycle Incidents | SWITRS/CAD Bicycle Incidents | Non-Reported Bicycle Incidents |
|--------------|-----------------------------------|------------------------------|--------------------------------|
| 2013 | 41 | 38 | 3 |
| 2014 | 67 | 19 | 48 |
| 2015 | 99 | 29 | 70 |
| 2016 | 103 | 28 | 75 |
| TOTAL | 310 | 114 | 196 |



Noteworthy Practices:

1. **Safety Plans:** Prepare a local or regional safety plan similar to the California Strategic Highway Safety Plan. Plans can be specific to a user, such as pedestrian and bicycle focused safety plans, or a more general safety plan, each including data, identified problems, solutions including engineering, education and enforcement, and implementation strategies based on data driven approaches to safety. Currently, TRPA is developing a regional Lake Tahoe Safety Plan and Jim Marino from the City of South Lake Tahoe is participating on the project development team (PDT).
2. **Data Sharing:** Share crash information with all public safety officials to document all crashes regardless of severity including property damage only (PDO), injury, and fatal. Require preparation of a formal crash report.
3. **Public Reporting:** Provide an online portal or a phone application for people to report an incident, near misses, etc. to help identify safety risk areas. This portal should be accessible by all public agencies.



Recommendations:

1. Participate on PDT for Lake Tahoe Safety Plan: The PDT includes representatives from all regional local jurisdictions, public safety personnel, the Lake Tahoe Bicycle Coalition, Caltrans, and Nevada Department of Transportation. This plan will include recommendations for a data-driven performance-based approach to project decision making for new or updated infrastructure. All PDT members will be expected to come to an agreement on this approach and formally sign a Memorandum of Understanding for future project planning.
2. Vet Noteworthy Practices on Improving Data Quality and Collection: Using the currently available data (CAD, anecdotal, SWITRS, Barton) create a pedestrian and bicycle crash report and map of high profile corridors. This may require additional funding, labor, or investment in updated technologies.
3. Utilize TRPA Bicycle and Pedestrian Count Program Data: Partnering with TRPA, the City recently installed two permanent bicycle and pedestrian counters. The City should use this information in conjunction with crash data to analyze and identify areas for critical improvement. Post infrastructure, signage, enforcement, and education improvements, monitor effectiveness through spot counts and targeted crash monitoring.



Phone Application Example: New Zealand Transport Agency ZeroHarm

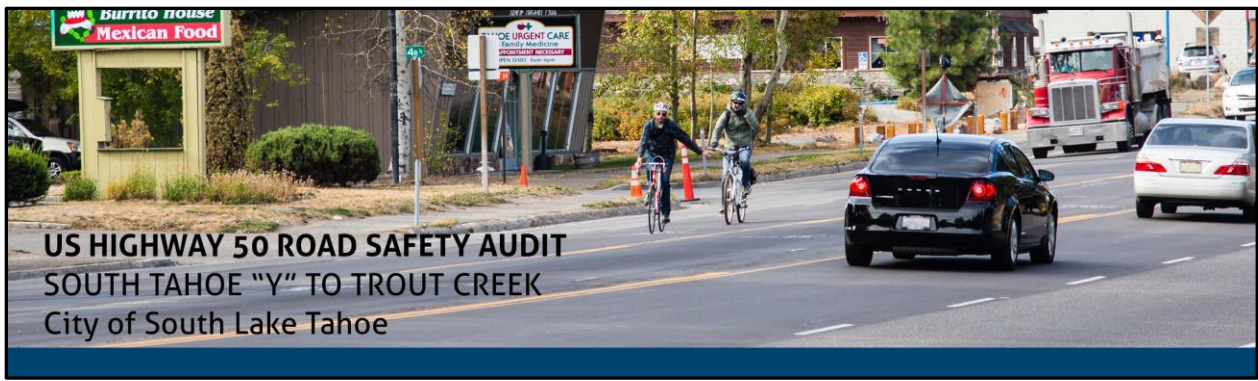
Locations for Improvement within Project Area:

Using the currently available data (CAD, anecdotal, SWITRS Barton,) create a pedestrian and bicycle crash report and map of the U.S. Highway 50 corridor to identify potential trends such as crashes that occur at night time, when crossing the roadway, or due to wrong way bicycle riding. The report should also include exact locations and frequency of pedestrian and bicycle crashes. Much of this work will be conducted as part of the Lake Tahoe Region Safety Plan. As part of this plan, partners should ensure the crash reporting and mapping system is a living tool that can be continually updated and analyzed.

Implementation Next Steps:

The City is in an opportune position in terms of safety data collection with the Lake Tahoe Region Safety Plan already under development. Implementation next steps are provided in relation to the development of this plan.

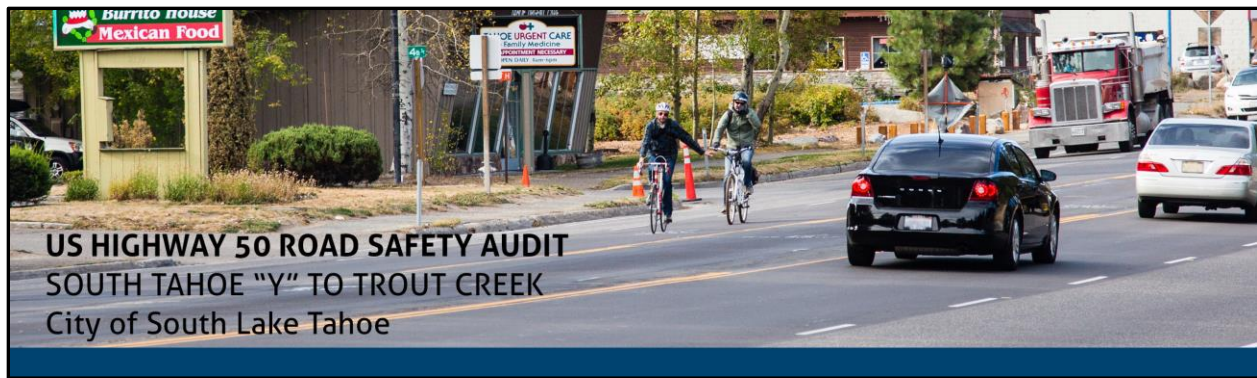
1. Participation: Continue active participation on Lake Tahoe Region Safety Plan PDT by City of South Lake Tahoe staff, Jim Marino.
2. Upgrading Procedures: Incorporate recommendations of Lake Tahoe Region Safety Plan which may include technology upgrades, pursuing funding for high priority safety projects, and updating crash reporting procedures. This may require pursuing or redirecting funding for new technologies and public safety staff.



3. Design of Infrastructure: When redesigning infrastructure, use an access management approach which will be outlined in the Lake Tahoe Region Safety Plan. Access management includes considering a variety of characteristics of the roadway, including historical crash trends, number of driveways, frequency of bicycle and pedestrian use, roadway curvature, existing and planned land-use, etc.
4. Funding Opportunities: Multiple funding sources can be used to upgrade facilities, technology, and fund staff. These include California Active Transportation Program non-infrastructure grants, California Senate Bill 1 (SB1) funding, California Office of Transportation Safety Grants, People for Bike Community Grants, Safety Routes to School, Highway Safety Improvement Program, and Every Day Counts Accelerated Innovation Deployment (AID).ⁱⁱ

ⁱ California Strategic Highway Safety Plan http://dot.ca.gov/trafficops/shsp/docs/SHSP15_Update.pdf

ⁱⁱ FHWA, <https://www.fhwa.dot.gov/innovation/grants/>



US HIGHWAY 50 ROAD SAFETY AUDIT SOUTH TAHOE "Y" TO TROUT CREEK City of South Lake Tahoe

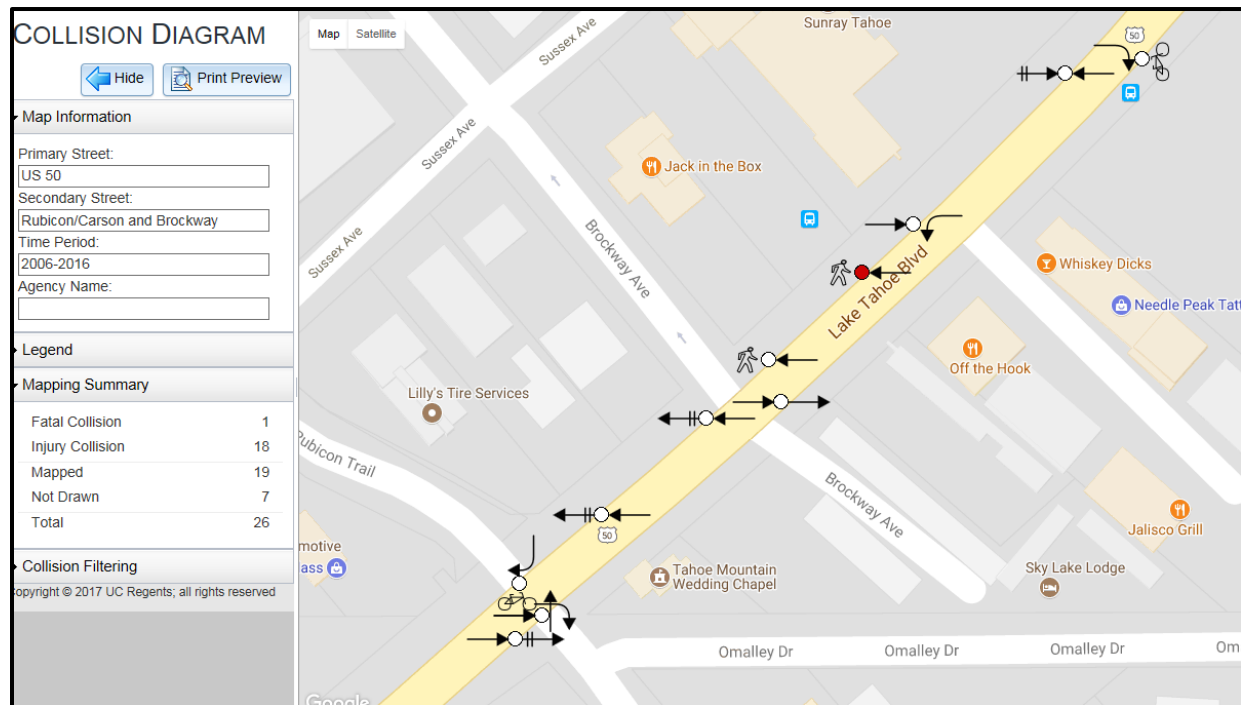
ENHANCED INTERSECTION DESIGN

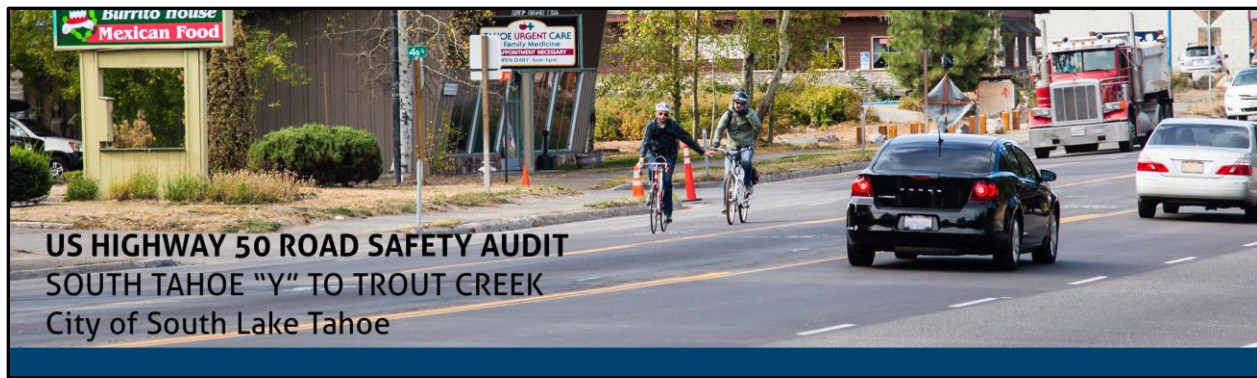
Issue Statement:

Intersections are planned conflict points where vehicles, pedestrians and bicyclists interact. Within the limits of the 2-mile U.S. Highway 50 project, there are five signalized intersections, 13 minor stop sign controlled side roads, and nearly 100 commercial driveways. All of these locations create conflict points between all modes. From 2006 to 2016, there were approximately 57 vehicle-vehicle injury crashes, seven pedestrian-vehicle injury crashes, and 16 bicycle-vehicle injury crashes reported in SWITRS at intersections. All of which produced an injury ranging from a fatality to a complaint of pain as shown in the table below.

| Crashes | Fatal | Severe Injury | Visible Injury | Complaint of Pain-Injury |
|--------------------|----------|---------------|----------------|--------------------------|
| Vehicle-vehicle | 0 | 4 | 16 | 63 |
| Bicycle-vehicle | 0 | 1 | 12 | 6 |
| Pedestrian-vehicle | 3 | 5 | 3 | 3 |
| Total | 3 | 10 | 31 | 72 |

See the figures below from the Transportation Injury Mapping System (TIMS) which translates SWITRS data into GIS. The figure below illustrates the concentrations of crashes at the intersections and accesses along U.S. Highway 50 between Rubicon Trail and past the bar, Whiskey Dick's.





Noteworthy Practices:

According to FHWA, intersection safety can be improved in a variety of ways including:

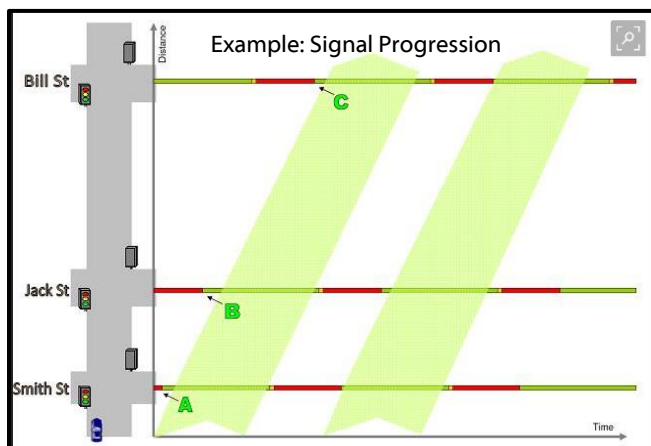
- Increasing awareness of intersections
- Design of intersections to reduce conflicts
- Driver navigation to reduce confusion
- Better operations of intersections
- Adequate sight distance at intersections
- Driver compliance with traffic control devices
- Accessibility for all users (ADA compliance)

Additionally, many of the safety improvements listed above can be accomplished for signalized and stop controlled intersections by providing high visibility crosswalks, coordinated traffic signals, bicycle signals, wayfinding, and lighting. Each of these treatments is summarized below in more detail.

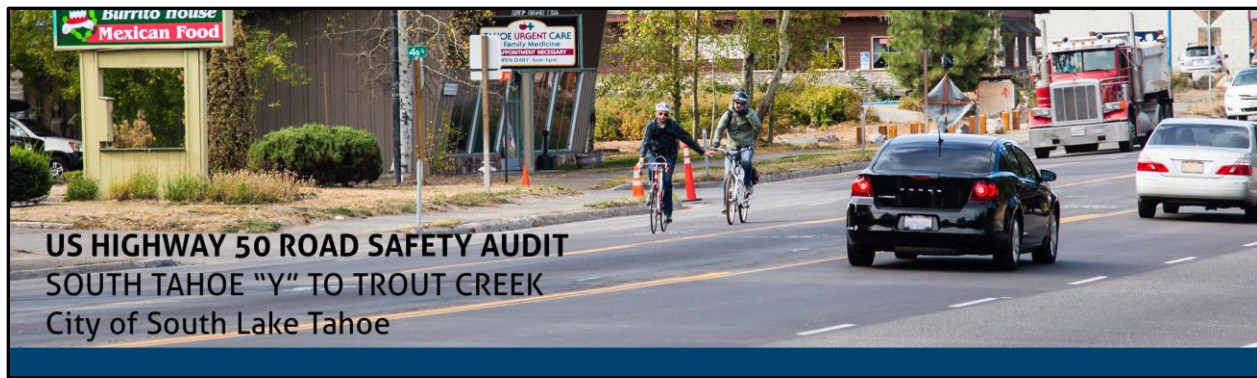
1. High Visibility Crosswalks: International markings on all approaches to the intersection provide reasonable expectations for pedestrians and drivers. These markings have a longer life than only transfers lines.
2. Coordinated Traffic Signals: Coordinated traffic signals can provide consistent progression and speeds along a roadway at a pace that is in line with the desired speeds and context.ⁱ



Example: International Markings

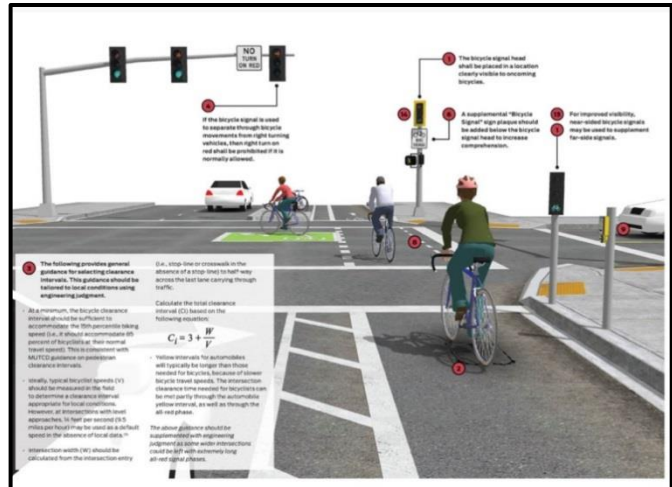


3. Bicycle Signals: Currently under experimentation, bicycle signals and a Leading Bicycle Interval (LBI), similar to a Leading Pedestrian Interval, are applicable at locations with high vehicle turning volumes. An LBI gives bicyclists a head start at intersections by giving bicyclists several seconds of green time before the concurrent vehicular movement receives the green indication. This reduces the risk of conflicts between bicyclists and turning traffic,



increases driver awareness of the bicyclist, and provides bicyclists an opportunity to make a lane change or left turn.ⁱⁱ

4. **Wayfinding:** Advance intersection ahead signs and illuminated street name signs can assist in increasing driver awareness of major intersections and potentially reduce confusion in advance of the dilemma zone.

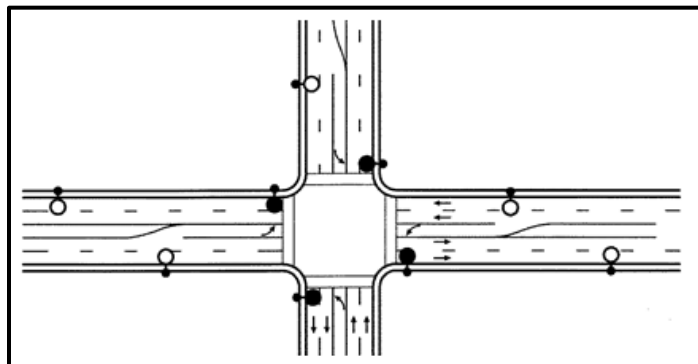


Example: Bicycle Signals



5. **Lightingⁱⁱⁱ:** Driving or walking on or across a roadway is less safe in darkness than in a lighted area due to the reduced visibility of hazards and pedestrians.^{iv} Roadway lighting is a proven safety countermeasure. The positive safety effects of lighting have been documented in various reports and publications.^v Lighting becomes critical where there are user conflicts as well as decision and dilemma zones. Recent research on intersection lighting indicates that when crosswalks are present, lighting should be planned and located to account for the presence of pedestrians and attempt to achieve positive contrast.^{vi}

Example: Appropriately spaced lighting

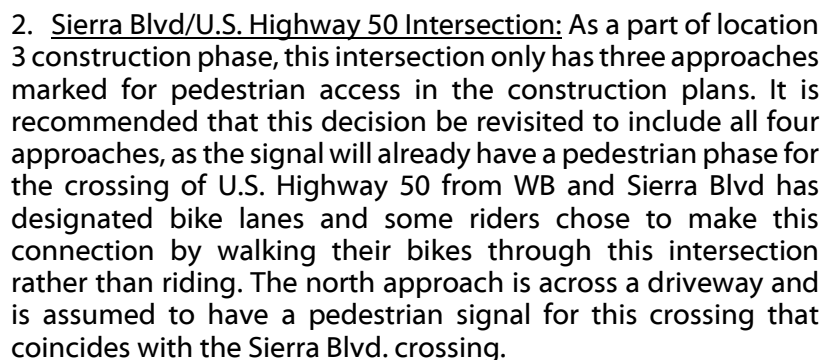


Recommendations:

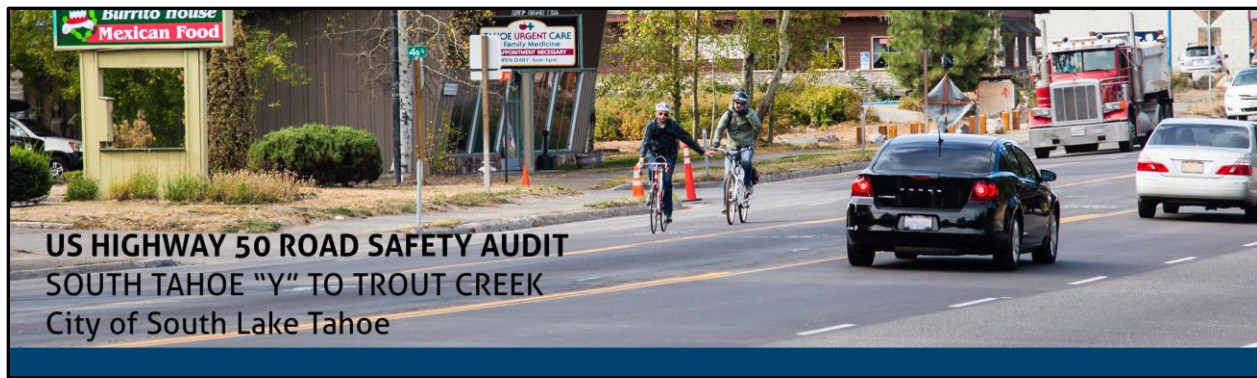
Improving the safety and operations at all intersections benefits all U.S. Highway 50 roadway users, including Tahoe residents and visitors. Recommendations for improving intersection safety and functionality are provided below by intersection.



1. Rubicon Trail/Carson Avenue/Brockway Avenue/U.S. Highway 50 Intersection Area:



3. Coordinating traffic signals: The signals will be coordinated as part of the current project. In the “Speed Management” portion of this report, revisiting the posted speed along the corridor is recommended and incorporating this desired target speed into the coordinated signal timing will keep drivers from exceeding the desired speed for this corridor.



4. **Advanced Street Name Signs:** Recommended for the major intersections to improve wayfinding and reduce confusion of out of town drivers.
5. **Lighting:** Additional lighting units are recommended in the functional area of intersections. This may be more easily accomplished at the signalized intersections where intersection lighting is already included in the plans and an electrical source exists. See the "Pedestrian and Roadway Lighting" section of this report for more information on lighting.

Implementation Next Steps:

1. **Update Project Plans through Change Order:** For location 3 construction phase, consider the recommendations of revised crosswalk markings at Carson/Rubicon/Brockway intersection area as well as Sierra Blvd. These locations are also excellent candidates for enhanced intersection lighting and advance intersection signing. The costs associated with the crosswalk additions should be negligible for a \$25M project and therefore cost effective. Level of service impacts should not be a concern with the addition of these crosswalks.
2. **Lighting Study:** Undertake an intersection lighting retrofit study for the corridor considering the benefits discussed here and in the "Pedestrian and Roadway Lighting" section of this report.
3. **Funding:** Funding sources should be sought for enhanced intersection lighting as well and for enhanced signing in the future. Applicable funding sources can be found in the Executive Summary of this report.

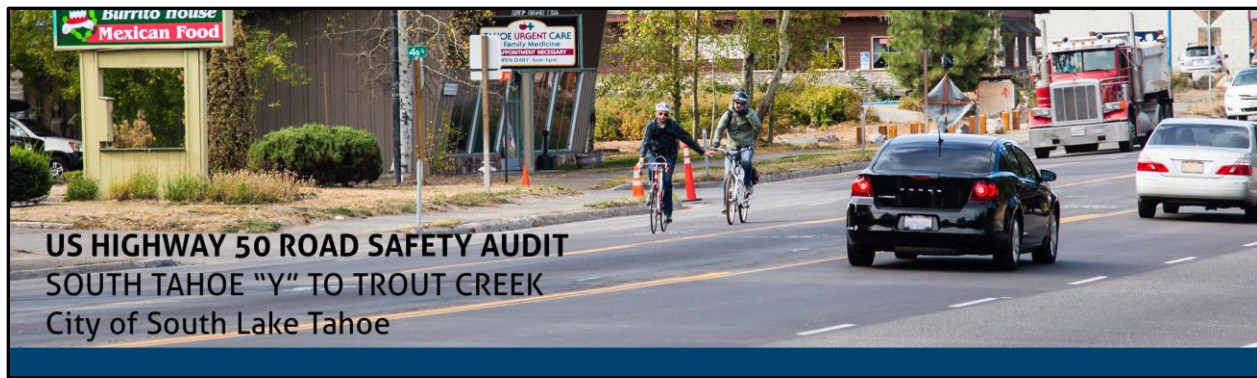
ⁱ Department of Transport and Main Roads, <https://www.tmr.qld.gov.au/-/media/Travelandtransport/Roadandtrafficinfo/Traffic-Signals-Information/Figure1.JPG?w=651&h=428&as=1&la=en&hash=0BF1791B75D096A9458B6AB41626A94083B14A13>

ⁱⁱ NACTO, <https://nacto.org/publication/urban-bikeway-design-guide/bicycle-signals/bicycle-signal-heads/>

ⁱⁱⁱ <https://safety.fhwa.dot.gov/intersection/conventional/signalized/fhwasa13027/ch9.cfm#s95>

^{iv} https://safety.fhwa.dot.gov/roadway_dept/night_visib/lighting_handbook/pdf/fhwa_handbook2012.pdf

^v FHWA, <https://safety.fhwa.dot.gov/intersection/conventional/signalized/fhwasa13027/ch9.cfm>



INFRASTRUCTURE IMPROVEMENTS FOR BICYCLIST SAFETY

Issue Statement:

The current project on U.S. Highway 50 will do much to improve safety for bicyclists by providing a continuous bike lane along the length of the project. However, on-roadway bicyclists are traveling along a corridor with no buffer between them and motor vehicle traffic that is moving at a high speed at 40 mph. When a crash occurs at that speed, it will usually result in a fatality for a bicyclist. Additionally, each intersection and driveway along the corridor represents a conflict point where vehicles and bicyclists are at greater risk. The risk of these conflict points increases with wrong-way travel by bicyclists because a motorist entering the highway from a driveway may not be expecting or looking for bicyclists who are riding the wrong way.

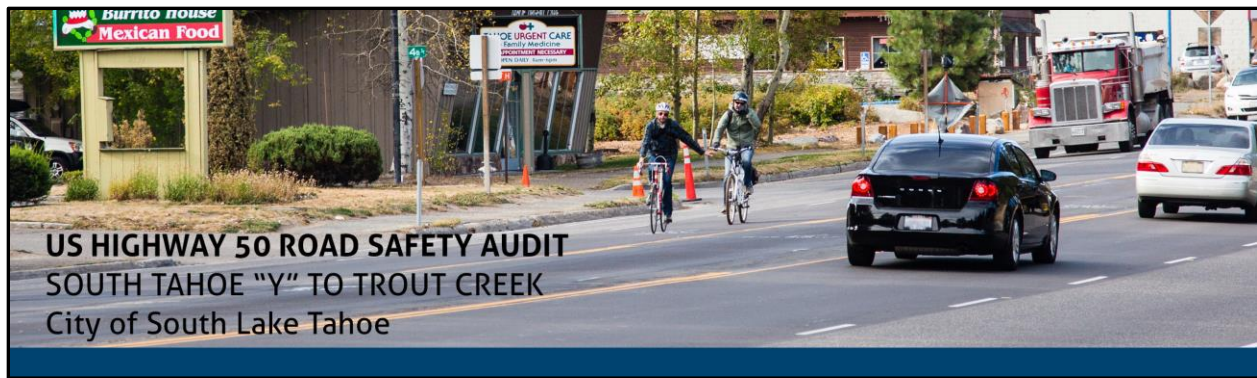
Wrong way travel is prompted at some places along the corridor because of the lack of adequate places for a bicyclist to cross U.S. Highway 50. A significant portion of fatal bicycle crashes, in some localities, have been found to occur with wrong-way riding.



Bicyclist safety is a concern for the corridor. From 2006 to 2016, there were 19 reported bicycle crashes, most of them occurring during the day and all of them resulting in an injury to the bicyclist. During that same period, the total number of injury crashes was 41, and bicycle injury crashes represent 46 percent of all injury crashes. This percentage is high considering bicyclists comprise a significantly smaller proportion of the traffic volume. During most of that reporting period, the speed limit on U.S. Highway 50 was posted at 35 mph, with the speed limit being raised to 40 mph in 2012. As noted in the "Safety Data" section of this report, the reported crash data does not tell the complete story of the risk to bicyclists. According to the City of South Lake Tahoe's Computer-Aided Dispatch records from 2013-2016, police were called out on 31 vehicle-bicycle crashes, with 23 of those crashes resulting in bicyclist injuries, and six of those crashes occurring at night.

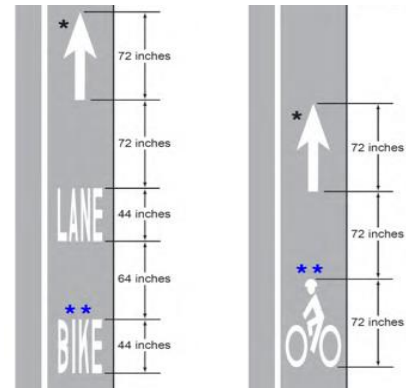
Emerging Practices:

Safety increases for bicyclists when conflict points are reduced and speed and the differences in speeds between vehicles and vulnerable users are decreased. Where there are conflict points, the bicyclist should be not only visible, but easy to see and predictable. At intersections, driveways, and bus stops turning vehicles are crossing the bike lane. Pavement markings, signs, and lighting can be used to enhance the conspicuity of the bicyclist and to increase awareness of both the bicyclist and the motorist to the conflict. Providing buffer space between bicyclist and fast-moving traffic increases safety, comfort, and level of stress for the bicyclist. Connectivity of the overall bicyclist network greatly influences the behaviors of bicyclists. The location of intersecting bikeways and crossings of an arterial should be coordinated to improve connectivity of the bikeway network and decrease the incidence of wrong-way riding.



Recommendations:

1. **Two-Way Left Turn Lane Configuration:** There are places on the corridor where the two-way-left-turn-lane (TWLTL) remains continuous even though there are no access points into which a vehicle may turn. When the TWLTL is not needed to accommodate turning movements into driveways and side streets, the lane can be narrowed to provide additional width or buffer space for the bicyclists. The Caltrans Highway Design Manual specifies a transition of $L = WV$ for 40 mph, where L is the length of the taper in feet, W is the width of the taper in feet, and V is the posted speed in miles per hour.ⁱ



Caltrans Bike Lane Markings:
Word legend is shown on the left.
Helmeted bicycle symbol is shown on the right.
(From CA MUTCD Figure 9C-3)

2. **Bike Lane Marking:** The project currently includes the bike lane marking with word legend. Since South Lake Tahoe is an area with international visitors and many locals for whom English may not be their first language, the bike lane marking with symbol message is recommended. The City uses the helmeted bicycle symbol and consistency within the area would be advisable. The directional arrow should reinforce riding in the correct direction.
3. **Bike Lane Striping:** Currently, the project plans include bike lane markings on the approach to and departure from some, but not all intersections. With the number of driveways along the corridor and the interval between the bike lane markings, it is recommended that the number of bike lane markings be increased. In particular, bike lane markings should be used at all intersections and bus stops. When the interval between these bike lane markings is greater than 500 feet, markings should be added to reinforce for motorists and bicyclists the purpose of the space.

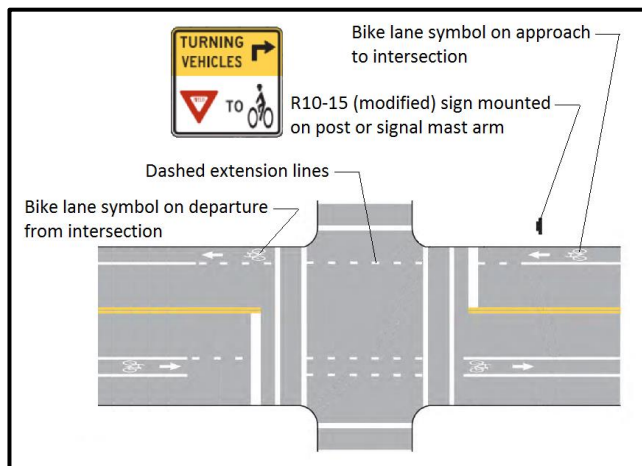
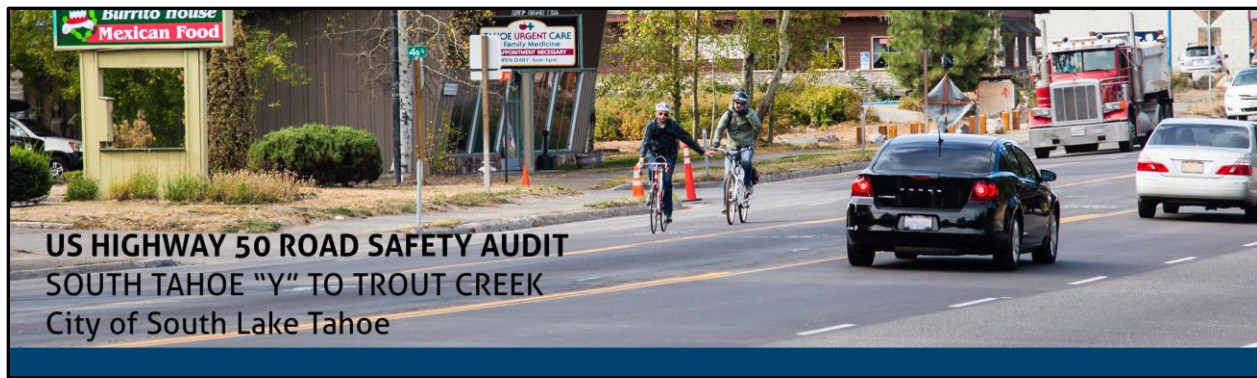


Diagram of Recommended Intersection Treatments
(Adapted from CA MUTCD Figure 9C-106)

The current plan includes dashed bike lane markings on the approaches to intersections that don't have auxiliary right-turn lanes. Increase attention to the bike lane conflict by adding a bike lane pavement marking on the approach to the intersection, extending dashed lines for the bike lane across the intersection, and adding a turning-vehicle-yield-to-bikes sign is advised.ⁱⁱ The California supplement to the MUTCDⁱⁱⁱ indicates



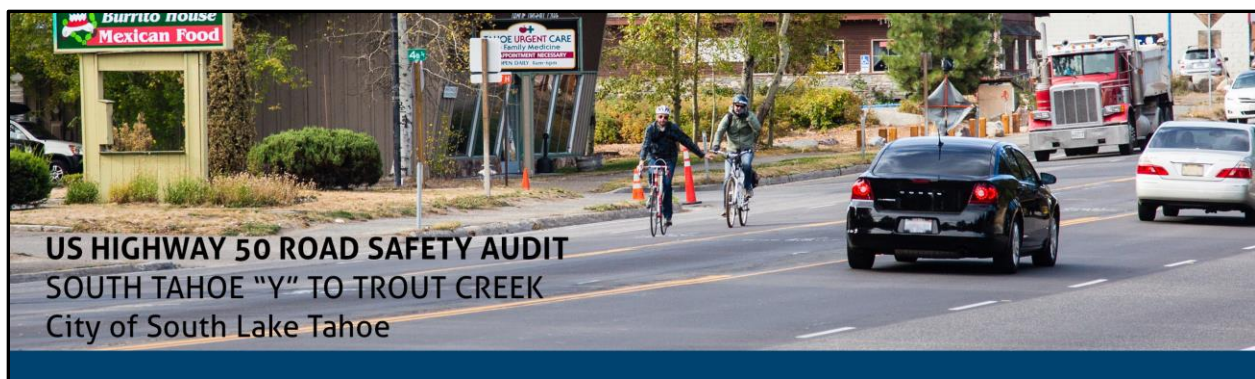
that, while not a typical application, bike lane markings may be extended through intersections. This is also recommended in the Lake Tahoe Complete Street Resource Guide.^{iv} The recommended sign is a modification to MUTCD sign R10-15, which is the turning-vehicles-yield-to-pedestrians sign.

4. **Connectivity:** Where there are bikeways intersecting U.S. Highway 50, either provide an adequate crossing for bicyclists or consider aligning the bikeway onto another side street where there is a signalized intersection.

Locations for Improvement within Project Area:

1. **Narrow TWLTL to Increase Bike Lane Width:** Between the hardware store driveway at 186+35 and the intersection at Edgewood Circle there is a distance of approximately 850 feet where there are no access points. With fewer conflicts, traffic is likely to pick up speed in this section, so having more space for bicyclist would be beneficial. It is recommended that TWLTL be narrowed to provide two-foot buffers between the bike lanes and the adjacent motor vehicle lanes. The transitions for this could be accomplished in less than 100 feet, providing a 650-foot section with buffered bike lanes, while leaving median space to maintain snow removal operations.
2. **Bike Lane Markings and Signs:** Change all bike lane markings to the helmeted bike symbol and add bike lane markings (BL) at the locations listed below. As described in the "Transit Stop Design" section of this report, shared-lane markings (SLM) should be added in places where buses and bicyclists are sharing the space at bus stops. Add dashed extension lines (DEL) across intersections at the locations listed below. Add the sign turning-vehicles-yield-to-bicyclists (R10-15), with the bicyclist symbol replacing the pedestrian symbol at intersections listed, where there is no right turn lane.

| Location | Description | Add Pavement Marking | Add Sign |
|-----------|------------------------|----------------------|-----------------|
| 98+75 EB | Long interval | BL(1) | |
| 112+97 EB | Bus stop | BL(2) & SLM(1) | |
| 114+50 EB | Driveway | DEL | |
| 116+00 EB | 2 nd Street | BL(1) & DEL | R10-15 modified |
| 123+46 EB | Bus stop | BL(2) & SLM (1) | |
| 125+70 EB | Winnemucca Ave | DEL | R10-15 modified |
| 128+00 EB | Truckee Drive | BL(1) & DEL | R10-15 modified |
| 130+70 EB | Bus stop | BL(2) & SLM (1) | |
| 137+50 EB | Long interval | BL(1) | |
| 143+60 EB | River Drive | BL(1) & DEL | R10-15 modified |
| 148+50 EB | Lodi Ave | BL(1) & DEL | R10-15 modified |
| 153+00 EB | Stockton Ave | BL(1) & DEL | R10-15 modified |
| 154+06 EB | Bus stop | SLM, DEL, & BL | |
| 157+80 EB | Sierra Blvd | BL(1) & DEL | R10-15 modified |
| 163+00 EB | Reno Ave | BL(1) & DEL | R10-15 modified |
| 164+70 EB | Bus stop | DEL, SLM(1), & BL | |
| 167+20 EB | Carson Ave | BL(1) & DEL | R10-15 modified |



Location Table Continued:

| | | | |
|-----------|-------------------|----------------------|-----------------|
| 173+22 EB | Bus stop | BL(2), DEL, & SLM(1) | |
| 178+50 EB | Long interval | BL | |
| 184+20 EB | Blue Lake Ave | BL(1) & DEL | R10-15 modified |
| 180+65 WB | Bus stop | BL(2), DEL, & SLM(1) | |
| 176+00 WB | Long interval | BL | |
| 168+00 WB | Rubicon Trail | BL(1) & DEL | R10-15 modified |
| 161+09 WB | Bus stop | BL(2), DEL, & SLM(1) | |
| 155+00 WB | Silver Dollar Ave | BL(1) & DEL | R10-15 modified |
| 151+78 WB | Bus stop | BL(2), DEL, & SLM(1) | |
| 149+10 WB | Lodi Ave | BL(1) & DEL | R10-15 modified |
| 138+22 WB | Bus stop | BL(2), DEL, & SLM(1) | |
| 133+50 WB | Long interval | BL | |
| 127+44 WB | Bus stop | BL(2), DEL, & SLM(1) | |
| 116+00 WB | Long interval | BL | |
| 104+00 WB | Long interval | BL | |
| 98+00 WB | Long interval | BL | |

3. **Realign Intersecting Bikeways.** There is a South Lake Tahoe bikeway bike route on River Drive. For bicyclists turning from River Drive to travel westbound on U.S. Highway 50, there is not an adequate crossing, which may lead to wrong-way riding in the bike lane. River Drive connects to Lodi Avenue, and Lodi Avenue has a signalized intersection under this project. Relocate the bikeway on River Drive to Lodi Avenue to facilitate bike crossings of U.S. Highway 50.
4. **Remove Obstructions from Bike Lane:** Although not observed during the RSA, observations by local agency staff noted that sewer manholes are being placed directly in the bike lane along the project area. This is not best practice as it creates an environment where bicyclists may swerve to avoid the manhole, or potentially become unbalanced by riding over it. For location phases 2 and 3, project plans should be updated to remove manholes from bike lanes, possibly using angle joints.

Implementation Next Steps:

1. **Change Order to Current Project:** Modifications of pavement markings, signs, and manhole relocation can be included in the current project through change orders.
2. **Relocate Bike Route:** South Lake Tahoe maintenance forces can relocate the bike route to Lodi Avenue from River Road. City staff should identify other similar locations where bikeways or routes intersecting U.S. Highway 50 can be located where there are adequate crossings of the highway.

ⁱ Caltrans, *Highway Design Manual 6th Edition*, "Intersections at Grade", p. 400-27. <http://www.dot.ca.gov/design/manuals/hdm.html>

ⁱⁱ FHWA, *Small Towns and Rural Multimodal Networks*, 2016, p. 3-14.

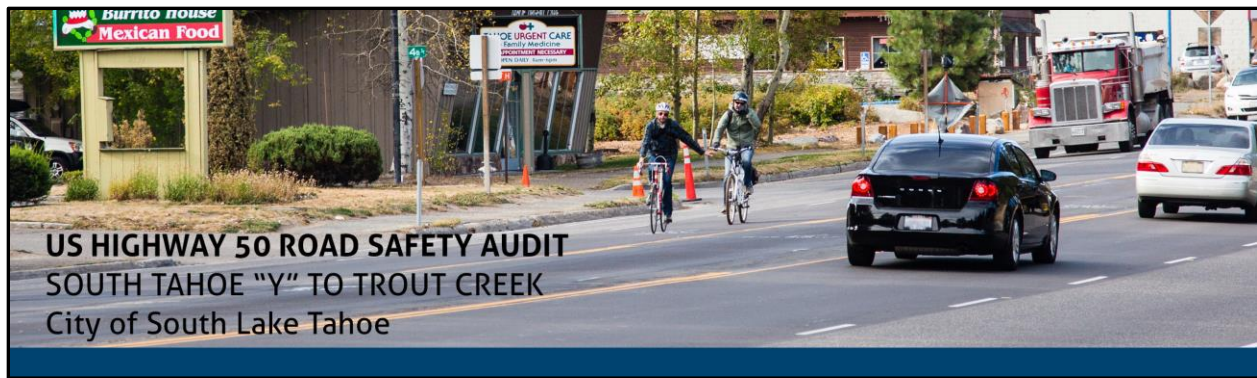
https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/small_towns/fhwahep17024_lg.pdf

ⁱⁱⁱ Caltrans, *California Manual on Uniform Traffic Control Devices*, 2014 Edition Revision 2, pp. 1381, 1384.

http://www.dot.ca.gov/trafficops/camutcd/docs/2014r2/CAMUTCD2014_rev2.pdf

^{iv} TRPA, Complete Street Resource Guide,

http://tahoempo.org/activetransportationplan/docs/appendices/Appendix%20A_Complete%20Street%20Resource%20Guide.pdf



PAVEMENT MARKING DURABILITY

Issue Statement:

Prior to this project, Caltrans practice has been to refresh the pavement markings on the U.S. Highway 50 corridor using Caltrans maintenance staff. The paint crew prioritizes freeway and major arterials first and refreshing the centerline before refreshing the shoulder and other markings. As a result, full refresh of the pavement markings has not occurred until the end of summer or fall. With much of the bicycling traffic on the corridor during the summer, the missing pavement markings on the bike lanes increase the safety risk to bicyclists. Additionally, paint does not bond well with retroreflective beads, which reduces night-time visibility of markings.

This U.S. Highway 50 project includes recessed methyl methacrylate (MMA) striping. This is specified for all limit lines and crosswalks in the project. MMA is considered one of the most durable pavement marking product, if installed properly, and bonds well with retroreflective beads. Research has shown that its wet-reflectivity is comparable to other available products.ⁱ It is not clear from the information available if this project includes MMA specifications for wet-reflectivity performance. Bike lane and bike loop symbols will not be recessed and can be expected to deteriorate more rapidly than the other pavement markings.



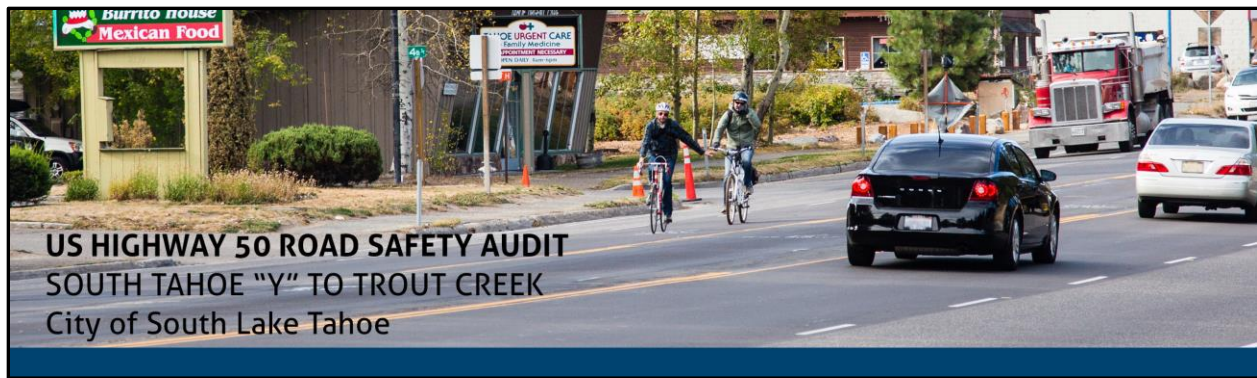
Bike Lane Pavement Markings
(Photo Source: ennisflintamericas.com)

State of the Practice:

Many agencies are choosing to install recessed, durable pavement markings such as MMA, epoxy, thermoplastic, and tape to extend the life of pavement markings, reduce maintenance intervals, and increase safety. The goal is to provide an adequate pavement marking on all roadways 365 days per year.ⁱⁱ MMA has excellent performance in locations with low temperatures^{iiiiv} and is very resistant to snow plowing if installed properly. Proper installation of these durable materials is vital to their performance; therefore, using a qualified and experienced contractor is necessary.^v



According to MnDOT's statewide pavement marking operations guidance^{vi}, wet-night visibility is an increasingly important marking issue. In Minnesota all wet-reflective/wet-recoverable material must be recessed to insure continued wet weather performance after snow plowing operations. The following figures show MnDOT's systemic approach to pavement marking for both longitudinal striping and pavement messages including crosswalks. One of the considerations for type of pavement marking is the presence or lack of lighting.



Recommendations:

1. Use Recessed Marking for Bicycle Facilities: According to Caltrans' construction documents, bike lane and bicycle loop detector symbols will not be recessed. It is recommended that these symbols be recessed, especially since this project currently has no corridor lighting nor enhanced intersection lighting for pedestrians beyond typical Caltrans standards.
2. Monitoring Effectiveness Post Implementation: MMA is a non-standard pavement marking material for Caltrans. On-going evaluation is recommended to consider if the durability, wet-retro-reflectivity, and recovery-retro-reflectivity performance are as expected, or if refinements to the selected products and methods of application are needed.
3. Update Restriping Schedule: Pavement marking maintenance should be scheduled as early as possible in the spring or summer so that bike lanes are clearly marked when they have the most traffic. Caltrans and the City of South Lake Tahoe should consider executing a cooperative agreement in which Caltrans provides funding to the City and the City schedules the contractor to refresh striping, particularly for bike lanes and crosswalks, on the U.S. Highway 50 corridor.

Locations for Improvement within Project Area: Project-wide.

Implementation Next Steps:

1. Change Order for Current Project: Update Caltrans' project documents and include a change order to use MMA for bicycle facilities project wide.
2. Monitoring: Caltrans and the City should create a plan for post implementation striping monitoring to measure effectiveness and adaptively manage issues.
3. Striping Cooperative Agreement: Caltrans and the City of South Lake Tahoe should consider executing a cooperative agreement in which Caltrans provides funding to the City and the City schedules the contractor to refresh striping, particularly for bike lanes and crosswalks.
4. Ensure restriping of crosswalks at end of season construction close-out: At the close of the 2017 construction season, the crosswalks were not restriped. Upon request of TRPA, Caltrans' contractors went back into the field to restripe crosswalks. It is recommended that Caltrans ensure their contractors are aware that all crosswalks must be restriped at the close of each construction season, even if the project is not yet complete to ensure proper driver and pedestrian expectations as well as visibility and safety.

ⁱ Caltrans, "Authorized Material List for Methyl Methacrylate Traffic Striping and Pavement Marking," 2017. http://www.dot.ca.gov/aml/docs/methyl_methacrylate_traffic_paint.pdf

ⁱⁱ MnDOT, *Pavement Marking Field Guide*, 2015. <http://www.dot.state.mn.us/trafficeng/pavement/doc-storage/mndotpavementmarkingfieldguide.pdf>

ⁱⁱⁱ Texas Transportation Institute, *Pavement Marking Demonstration Projects: State of Alaska and State of Tennessee*, FHWA, 2013. <https://www.fhwa.dot.gov/publications/research/infrastructure/pavements/12048/index.cfm>

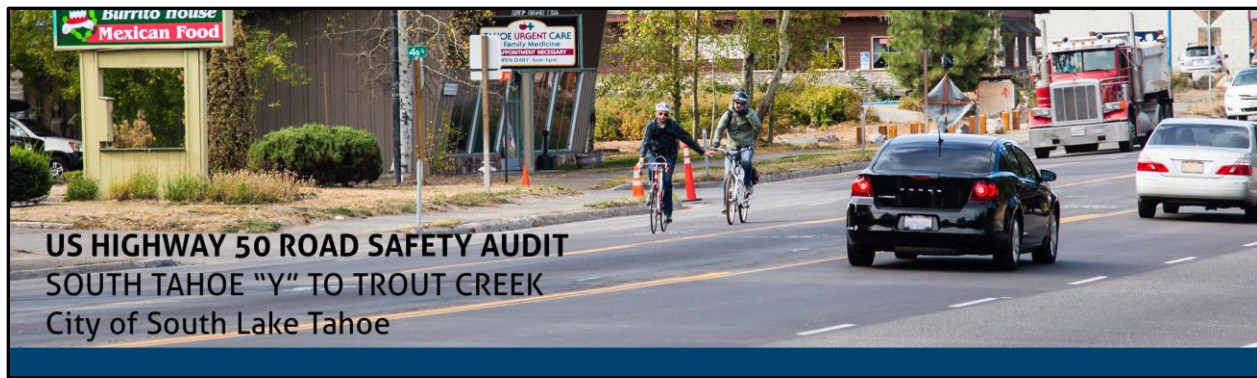
^{iv} TxDOT, *Pavement Marking Handbook*, Manual Notice: 2004-1.

http://onlinemanuals.txdot.gov/txdotmanuals/pmh/pavement_marking_material_descriptions.htm#i1021401

^v Infrastructure Canada, "Pavement Marking: Materials," Université Concordia.

<http://users.ensc.concordia.ca/~zayed/materials.html>

^{vi} MnDOT, "MnDOT Provisions for Pavement Marking Operations", Technical Memorandum No. 14-11-&-02, 2014. <http://www.dot.state.mn.us/trafficeng/publ/techmemo.html>



MID-BLOCK CROSSINGS

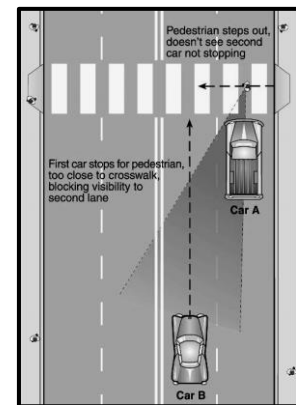
Motel 6/Grocery Outlet & Town and Country Shopping Area (Whiskey Dick's/Sunray Tahoe Hotel)

Issue Statement:

High speed, multi-lane roadways are challenging for pedestrians to cross. Pedestrians are faced with multiple threat situations, as shown in the image to the right, particularly on unmarked crosswalks. Popular pedestrian attractions and transit stops that increase desired crossing locations for pedestrians also increase opportunities for risk of crashes and injuries.

Marked pedestrian crossings along U.S. Highway 50 through South Lake Tahoe are sparse, especially along the 0.70 mile stretch between Tahoe Keys Blvd. and Sierra Blvd. Apart from the signalized intersections, the Motel 6/Grocery Outlet area and Lodi Ave. have the most significant pedestrian activity based on Caltrans and TRPA count information. Additionally, in the Town and Country Shopping area, anecdotally this is most likely a relatively high crossing area due to the surrounding businesses. Rubicon Trail is the closest marked crosswalk with the next closest marked crosswalk over a half mile away.

Example: Multiple Threat

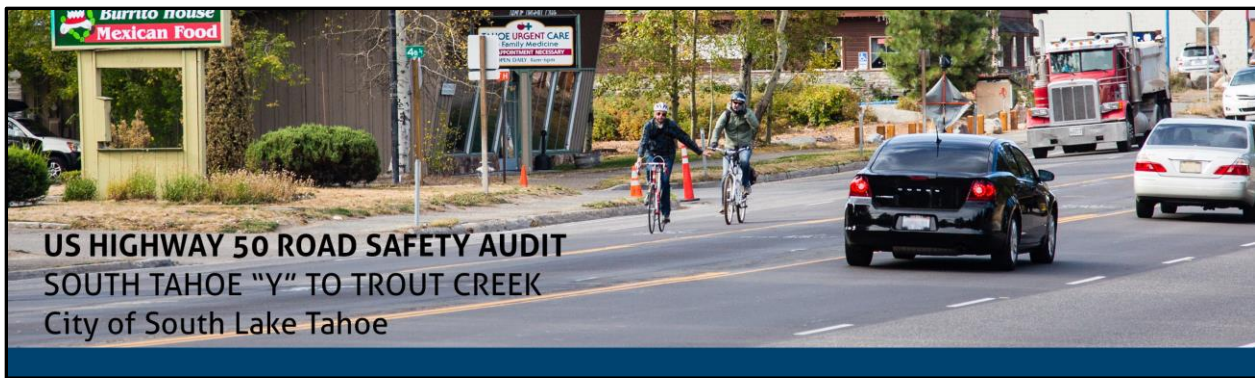


Seven midblock pedestrian crashes were reported between 2006 and 2016 with two fatalities in the Town and Country Shopping area. The current roadway configuration is conducive to higher (>40 mph) travel speeds, has long distances between marked crossings, creates long crossings and exposure to vulnerable users such as bicyclists and pedestrians, and allows continuous and uncontrolled left turn movements. Often, due to the long distances between marked crossings, pedestrians cross wherever is most convenient, but not necessarily at the safest locations (eg. based on driver expectations, good sight distance, number of conflicts). For pedestrians to safely cross a roadway, they must estimate vehicle speeds, adjust their walking speed, determine gaps in traffic, and predict vehicle paths.

Some of the pedestrian activity throughout this area is produced by TTD bus stops, especially in front of Motel 6/Grocery Outlet. Historical ridership data by stop is not available, though TTD has recently begun collecting ridership data by stop through passenger sampling. Summer 2017 data, though collected, is not considered accurate because the bus stops were closed for large amounts of the season due to the U.S. Highway 50 project construction. TTD will continue to collect ridership by stop data for 2017 – 2018 and will continue to collect data on a three-year cycle as required for federal reporting. This data should be considered when determining mid-block crossing and bus stop improvements. Throughout the area, many bicyclists and pedestrians connect between the South Tahoe Bikeway, businesses, and residences on the other side of U.S. Highway 50.

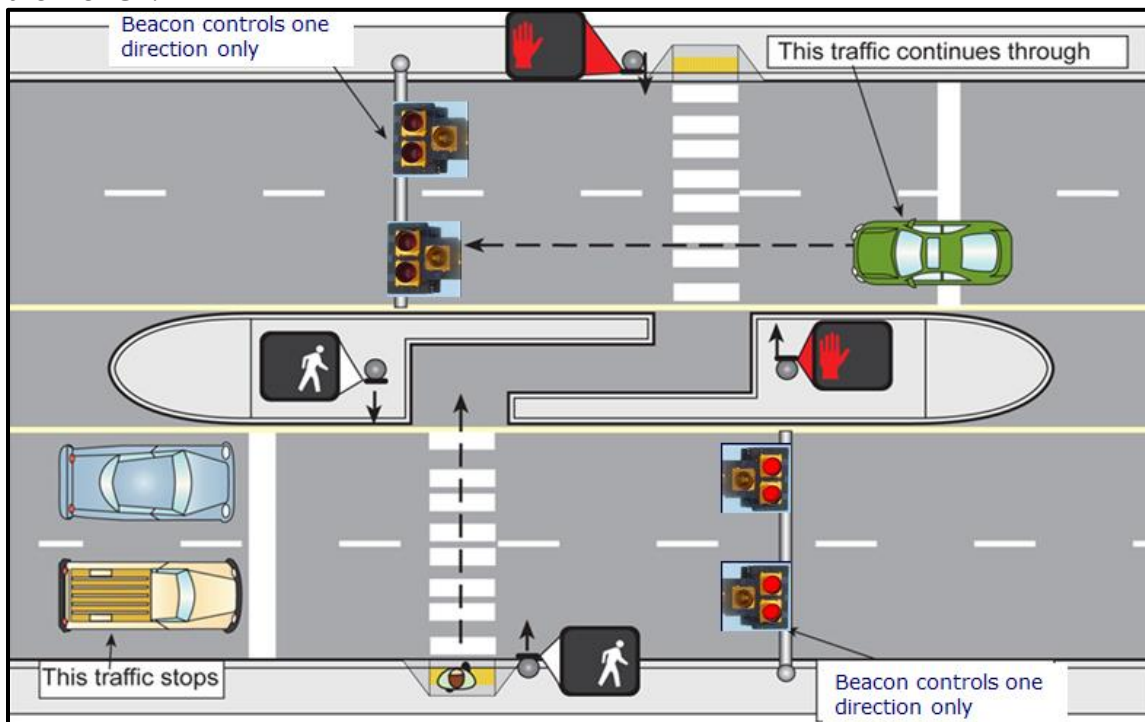
FHWA Proven Safety Countermeasures:

Controlled pedestrian mid-block crossings, which include either a signal or beacon, especially in locations where there is already natural pedestrian crossing activity, draws pedestrians to cross in a visible area that provides positive guidance for drivers to expect pedestrians in one location rather than in multiple locations. Additionally, installing raised medians or pedestrian crossing islands can

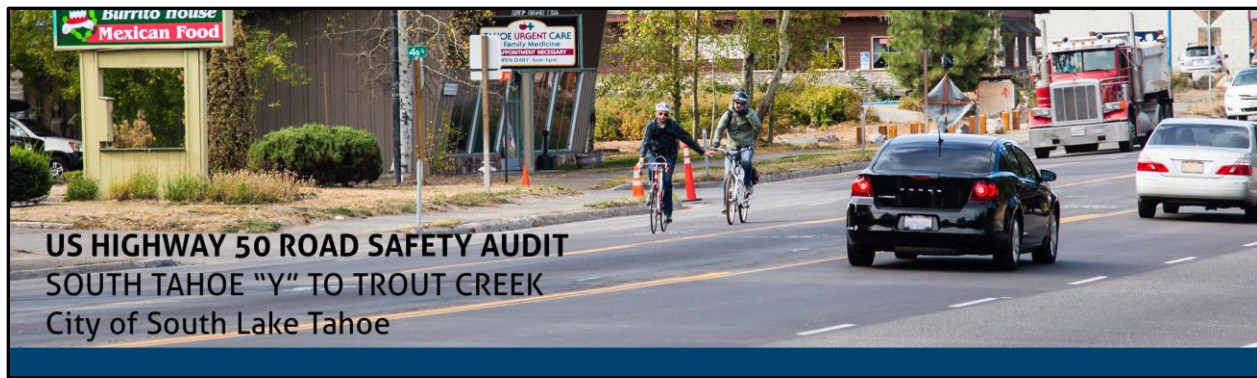


help improve safety by simplifying tasks and allowing pedestrians to cross one direction of traffic at a time. Identifying locations with the greatest functionality in relation to optimal crossing destinations, such as from a motel to grocery store or from one bus stop to a connecting route, will provide a safe and accessible pedestrian crossing environment for all roadway users.

1. **Median Islands:** Medians and pedestrian crossing islands in urban and suburban areas can result in a 46% reduction in pedestrian crashesⁱ.
2. **Pedestrian Hybrid Beacons (PHB):**ⁱⁱ The PHB is a traffic control device to help pedestrians safely cross busy and high speed roadways at midblock crossings and uncontrolled intersections. PHB's can reduce pedestrian crashes by 69%. PHB's can be connected to and timed with existing roadway signals and must be timed appropriately to allow traffic movement while also not incurring an undue delay for pedestrians who may decide to cross rather than wait if perceived as too long a wait time. PHB's warrants are less stringent than traditional pedestrian signals in the MUTCD.



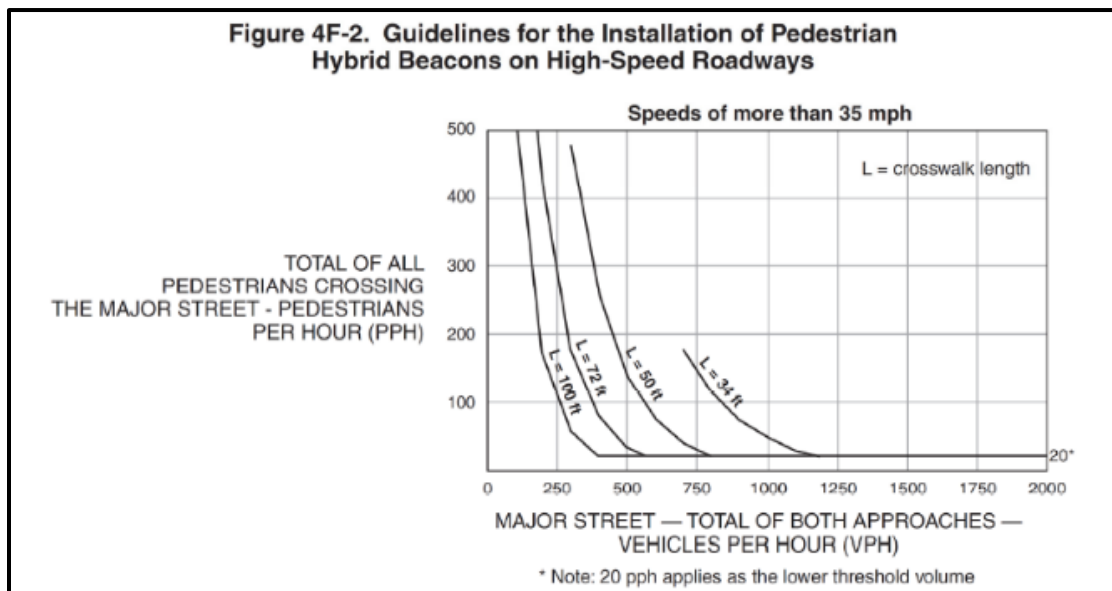
3. **Engineering Study:** Based on national researchⁱⁱⁱ and the guidance provided in the Federal and California MUTCD (Section 3B.18), an engineering study should be conducted before a mid-block crosswalk is considered. New marked crosswalks should include enhanced measures to reduce traffic speeds, shorten crossing distances, improve driver awareness, and include active warning of pedestrians. Additional measures are particularly important on roadways like U.S. Highway 50, where posted speeds are 40 mph or higher, on roadways with four or more lanes without a raised median, and with an Average Daily Traffic (ADT) of 12,000 or more.



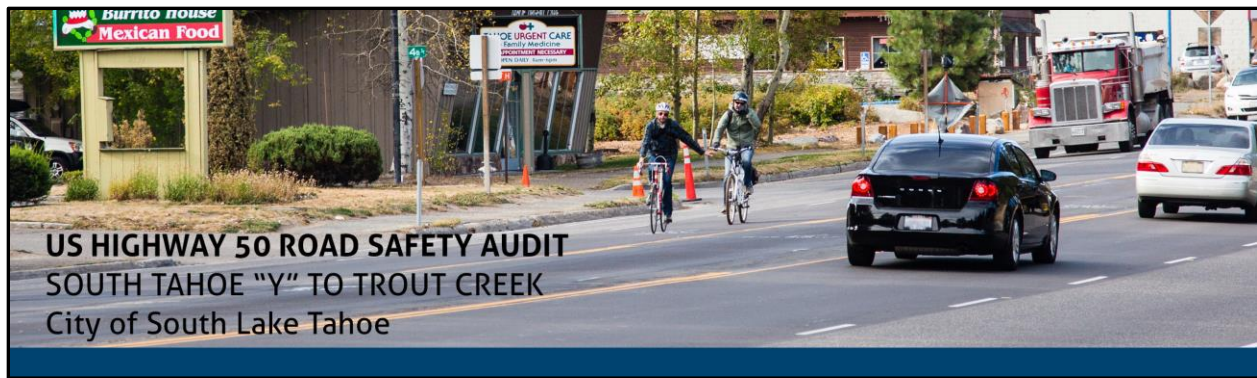
US HIGHWAY 50 ROAD SAFETY AUDIT SOUTH TAHOE "Y" TO TROUT CREEK City of South Lake Tahoe

Recommendations:

Identify locations along the corridor that would benefit from mid-block crossings, for example segments that have significant distances between controlled (signalized) marked crossings, segments with no access, locations that have established desire lines (origins and destinations on opposite sides of the streets), and transit stops in proximity to destinations. Preliminarily, this report suggests the Motel 6 / Grocery Outlet area and Town and Country Shopping area as potential mid-block crossings to consider.



1. **Lighting:** Install roadway and crosswalk lighting where pedestrians are crossing the roadway. For more information, please see "Pedestrian and Roadway Lighting" section of the report.
2. **Bus Stop Re-Location:** Assess the possibility of combining and relocating bus stops to reduce mid-block crossing at unmarked and uncontrolled crossings, ideally near the Motel 6 / Grocery Outlet area. WB bus stops at abandoned restaurant/Motel 6 (routes 50/53) and at O'Reilly Auto Parts (routes 50/53) are 1,000 feet apart. EB stops at Winter Electric (routes 13/50/53) and Grocery Outlet (routes 13/50/53) are 700 feet apart. By consolidating and moving the stops to a more central location, walking distance between stops is minimized. Please see "Transit Stop Locations Relative to Pedestrian Crossings" for more information.
3. **Conduct an Engineering Study:** Collect necessary data as shown in the table on the following page to assess feasibility of an enhanced crossing treatment near Motel 6 /Grocery Outlet and Town and Country Shopping areas. A simple assessment shown below with relevant data for the Motel 6/ Grocery Outlet location inserted. Consideration for a Pedestrian Hybrid Beacon is strong at this location based on this information. A similar assessment could be done for the Town and Country Shopping area.



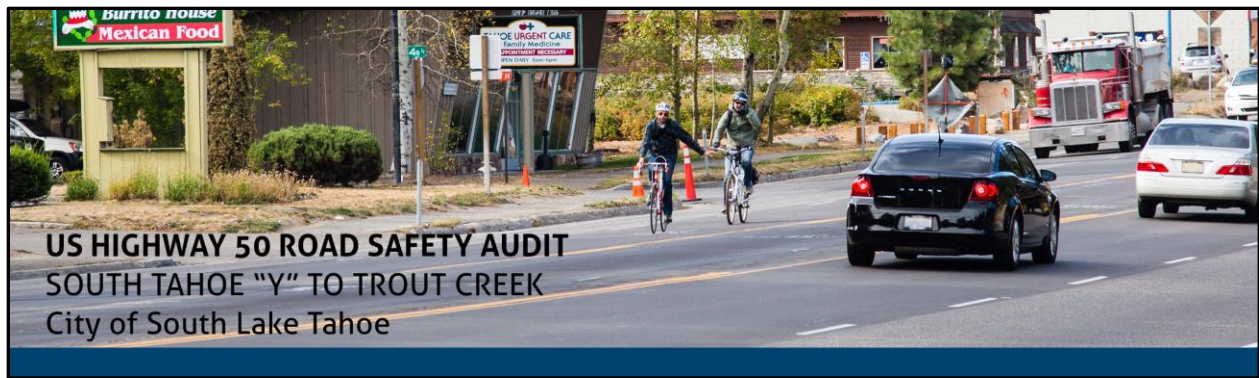
Locations for Improvement within Project Area: Although other opportunities exist for mid-block crossings, based on the RSA observations, pedestrian crossing counts, and crash data the most needed mid-block crossings are across U.S. Highway 50 between the Motel 6/Grocery Outlet and the Town and Country Shopping areas. Relocation and consolidation of bus stops from Tahoe Keys Blvd. throughout this area should be considered with the updated design. Additionally, relocating the existing driveways at both Grocery Outlet and Motel 6 should be considered to provide the best crossing location, transit stop location, and ingress and egress for business and parking lot circulation. On the last page of the section are two maps that provide recommendations on where mid-block crossing could be located for both areas. Additionally, the Grocery Outlet area map shows areas where mid-block crossings were observed to most typically occur.

| Location Context | Qualitative Assessment | Comment |
|------------------------------------|---|--|
| Posted Speed | 40 mph | Greater than 35 mph - high speed roadway which presents challenges for pedestrians |
| Lanes of traffic | 5 lanes | Multiple threat situation for pedestrians |
| Crossing Distance | ~70 feet | Long exposure for pedestrians |
| Traffic volume | Greater than 12,000 ADT | ~30,000 AADT ¹ |
| Distance to signalized crossing(s) | 1,200 feet west to Tahoe Keys Blvd. 1,900 feet east to Sierra Blvd | Excessive distance for pedestrians to "go out of their way" |
| Pedestrian counts | Additional counts needed | Warrants are based on crosswalk length and number of vehicles and pedestrians |
| Raised median | No | Increases risk for pedestrians |
| Roadway Lighting | No | Increases risk for pedestrians |
| Proximity to transit stops | 4 stops - 2 each direction within 1,000 feet | Can these be combined? |
| Crash data | 5 bike - vehicle and 2 vehicle-vehicle | This data includes SWITRS and CAD/911 data |

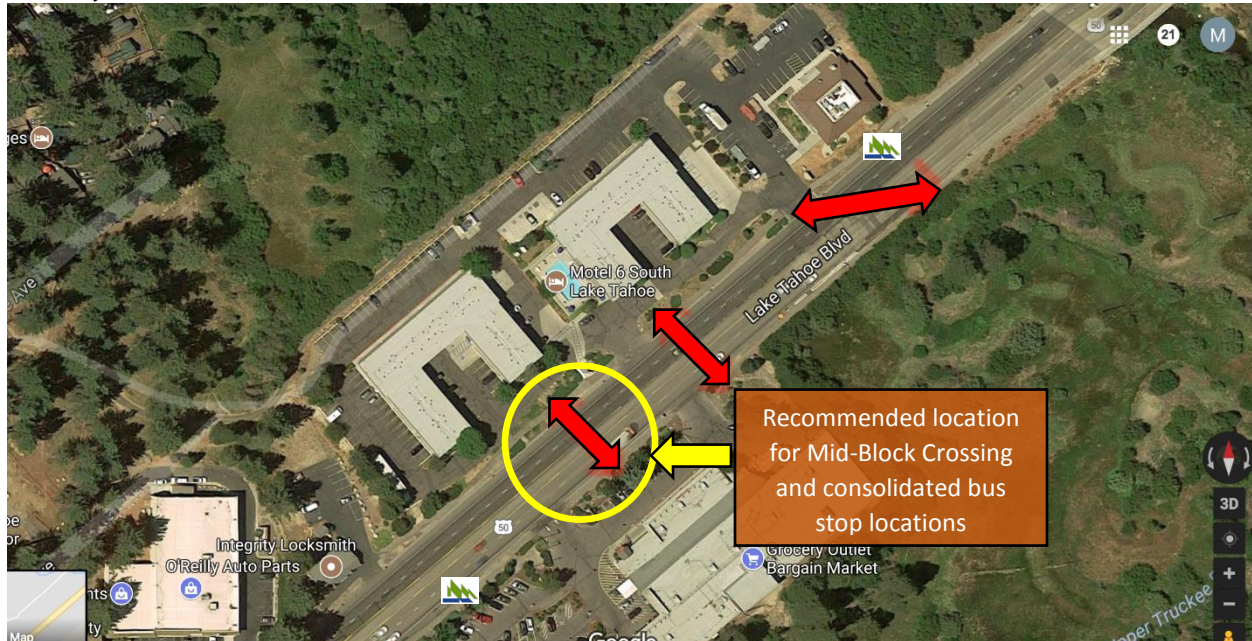
Implementation Next Steps:

1. **Develop and Memorialize Partnerships:** City of South Lake Tahoe and Caltrans with stakeholder input from transit operators, business owners, employers and property owners, should take on the responsibility of planning, engineering, and constructing the mid-block crossing.
2. **Analysis Needs:** Agency partners should continue to conduct pedestrian and bicycle counts to determine what location is ideal for the Motel 6/Grocery Outlet and Town and Country Shopping area crossings. There may be a need to take similar counts for the extent of the studied area to identify additional potential mid-block crossing locations. It is not expected that a mid-block crossing will be added into the existing U.S. Highway 50 Project, but rather analyzed and proposed as a new project when appropriate. TTD should consider the relocation of transit stops.
3. **Funding:** Multiple funding sources can be used for planning, preliminary engineering, and construction. Options include Highway Safety Improvement Program (HSIP), Active Transportation Program (ATP), and other funds available through SB 1. Links to these resources are provided in the Executive Summary of this report.

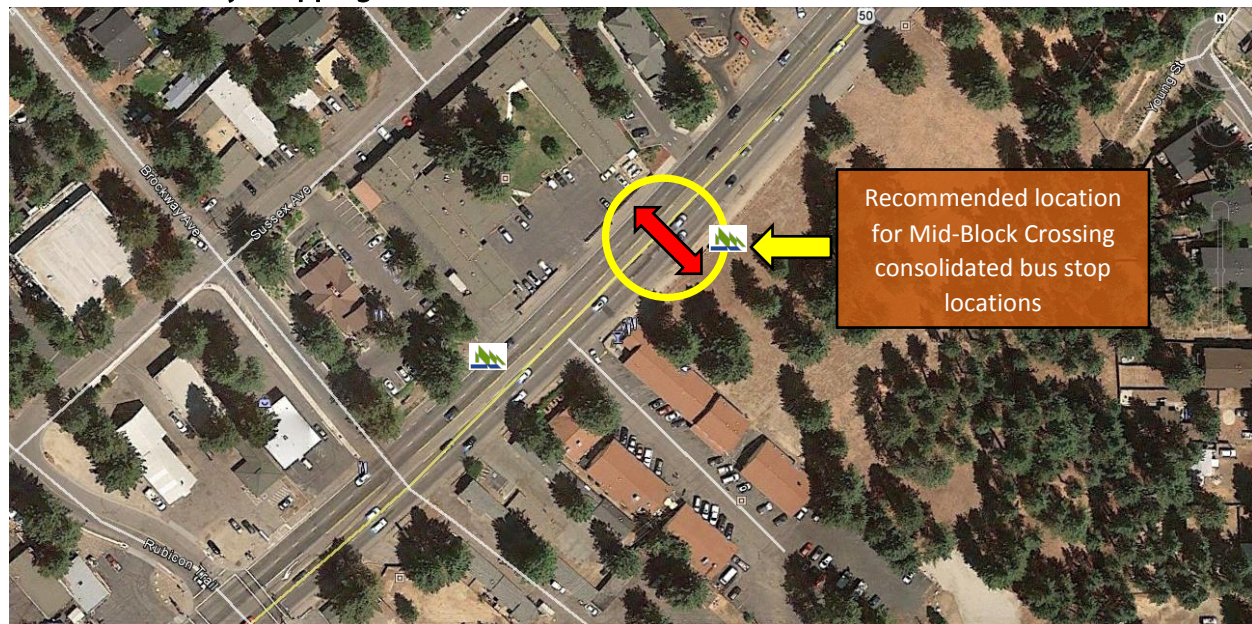
¹ FHWA, <http://www.dot.ca.gov/trafficops/census/volumes2015/Route44-50.html>



Grocery Outlet Area



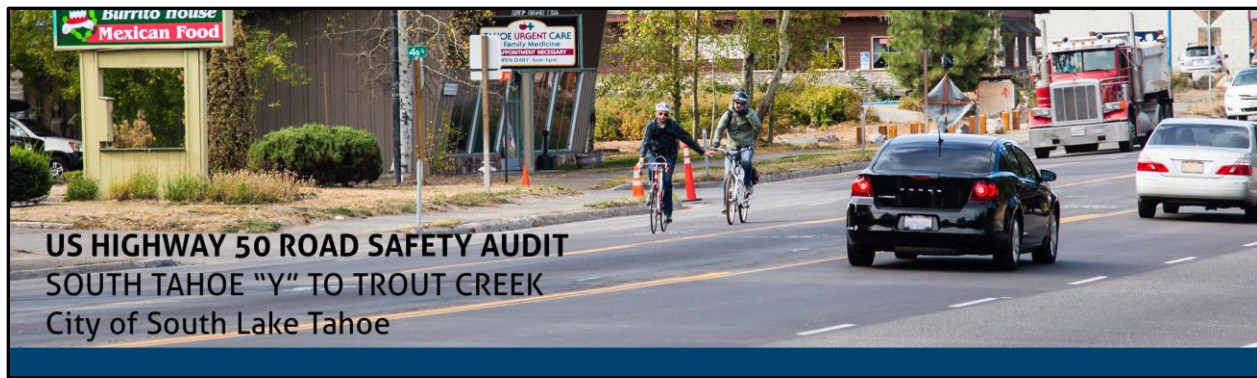
Town and Country Shopping Area



ⁱ FHWA, https://safety.fhwa.dot.gov/provencountermeasures/ped_medians/

ⁱⁱ FHWA, https://safety.fhwa.dot.gov/provencountermeasures/ped_hybrid_beacon/

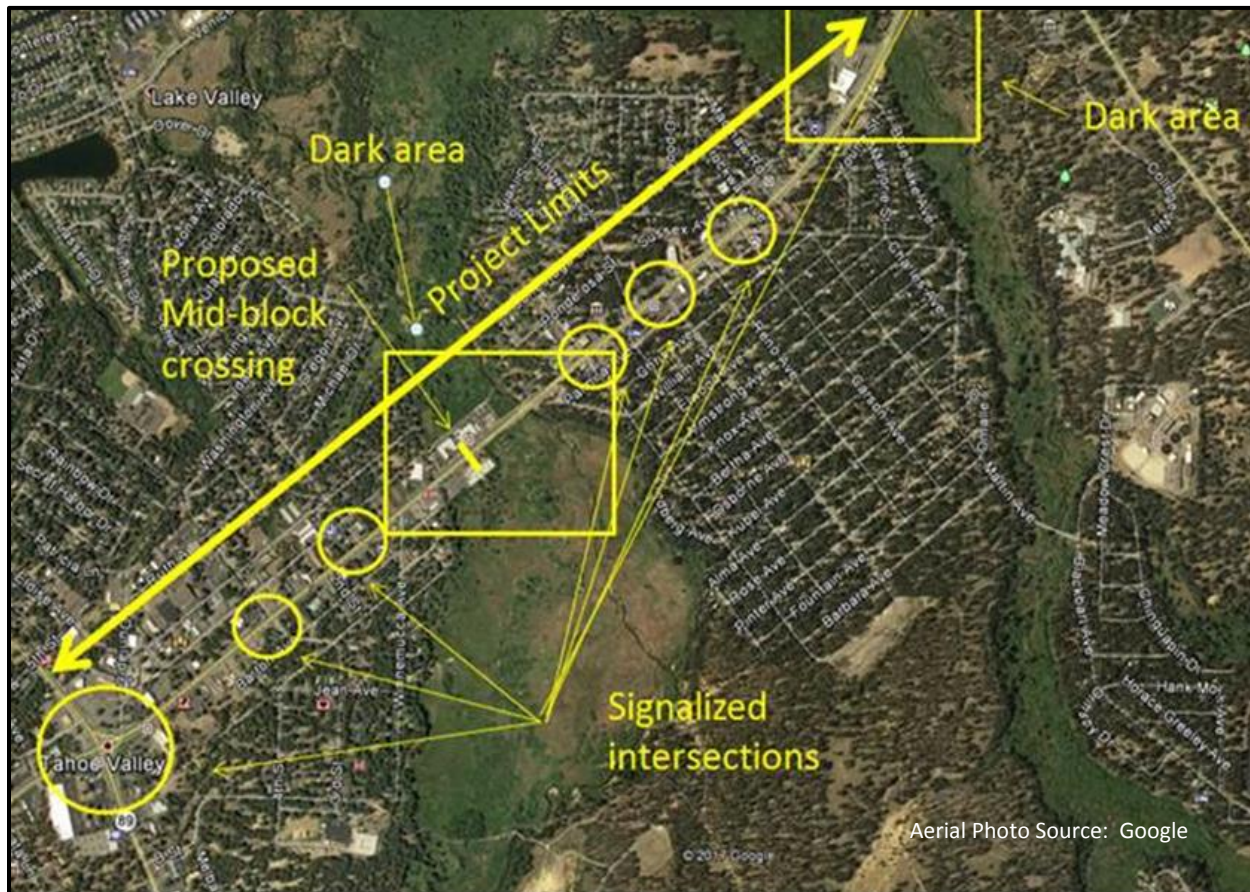
ⁱⁱⁱ FHWA-HRT-04-100

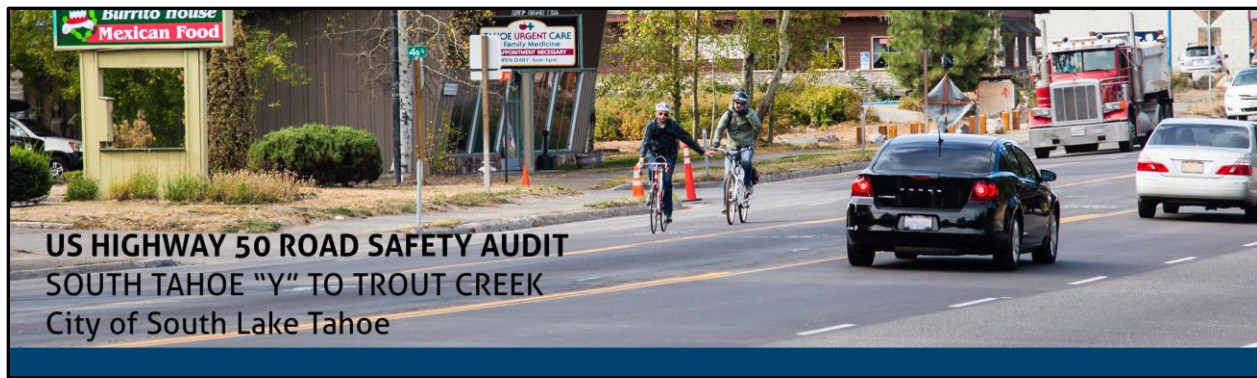


PEDESTRIAN AND ROADWAY LIGHTING

Issue Statement:

U.S. Highway 50 is a dark corridor, with many trees and sections where there is no roadside development casting light. Lighting would be a considerable improvement for pedestrians, bicyclists, and motorist safety. Under the current project, lighting is being installed at the signalized intersections. However, there are many unmarked crosswalks along the corridor and locations where pedestrians have frequently been observed crossing mid-block where lighting will not be included. Although a well-known issue, the City of South Lake Tahoe and Caltrans were unable to reach an agreement to cover the cost of installation and the ongoing maintenance of the roadside features. Darkness or the absence of lighting results in a disproportionately large number - in relation to nighttime traffic volumes - of crashes and fatalities for pedestrians. Pedestrians are the most vulnerable population on roads at night, and in terms of crash reduction, benefit the most from street lighting. Pedestrians are estimated to be between 3 and 6.75 times more vulnerable in the dark than daylight. According to FHWA, at speeds above 40 mph roadway lighting provides visibility of objects beyond the effective range of headlights.



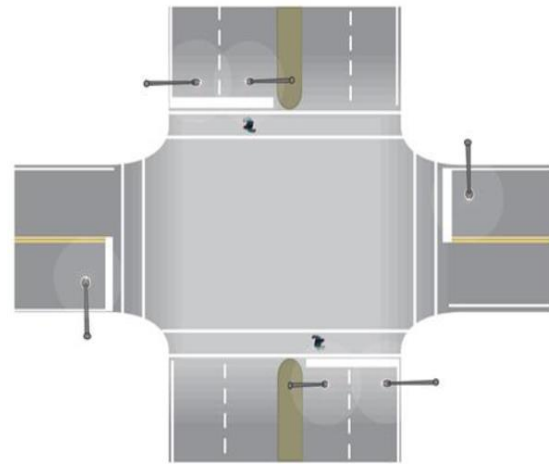


Proven Safety Counter Measures:

Lighting is a proven safety countermeasure. Street lighting can reduce pedestrian crashes at night by approximately 50 percent, a value that is higher than for other crash types. Lighted intersections and interchanges tend to have fewer crashes than unlighted intersections.ⁱ

Recent research to improve lighting at midblock pedestrian crosswalks suggests it may be desirable to locate poles approximately one third to one half the luminaire mounting height back from the crosswalk to improve lighting for pedestrians. This may require separate poles for signal equipment and luminaires.

Street lighting improves pedestrian visibility and personal security. On streets with trees, street lighting scaled to pedestrians, such as low lights, illuminate the sidewalk even after the trees grow big and tall. Street lighting improves safety by allowing pedestrians and motorists to see each other.

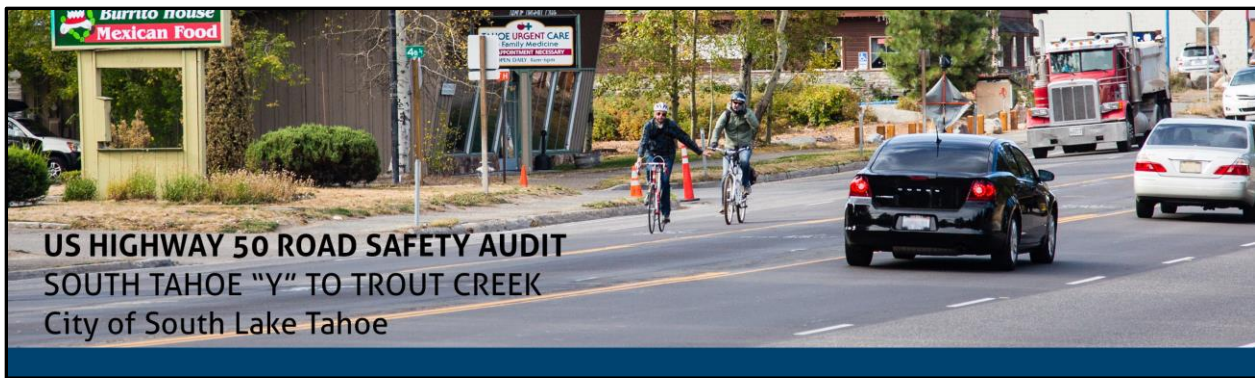


Recommended placement of luminaires at an intersection

1. Two-sided lighting, which would require some form of island in the median, should be considered along wide streets, such as U.S. Highway 50. It is especially important to provide lighting not only at the crossings, but lighting that lights the crosswalk itself.ⁱⁱ
2. Correct placement of lighting at crosswalks can significantly increase the visibility of those using the crosswalk. Lights that are directly overhead or behind the pedestrian places the pedestrian in shadow or silhouette. Providing advanced lighting by placing overhead lights between the crossing and oncoming traffic provides the best illumination for pedestrians.ⁱⁱⁱ

Recommendations:

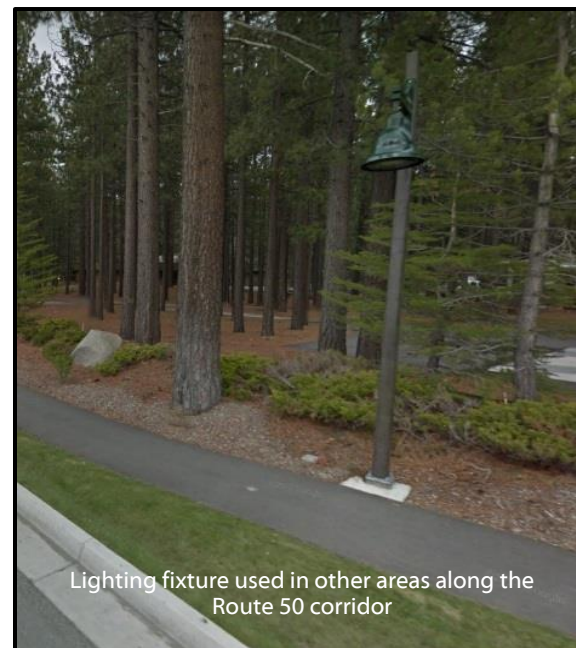
1. Adjust Light Placement: Modify placement of luminaires at signalized intersections in current plans, or supplement with additional lights so pedestrians at the intersection are illuminated on the side from which traffic is approaching, as described in "Enhanced Intersection Design" section of this report.
2. Advanced Lighting: Extend lighting from the signalized intersections in each direction to enhance visibility of the conflict areas for pedestrians, bicyclists, and motor vehicles.
3. Add More Lighting Overall: Add lighting along the length of the corridor to improve safety for all users who may be crossing at locations other than signalized intersections. This recommendation may be facilitated by placing conduit as part of the current project for installation of lighting later. Alternatively, lights could be installed with aerial overhead wiring^{iv} as an interim measure until a future project can underground service to the lamps.



4. Revisit Conduit Size: The conduits in the project for all signalized intersections may have been oversized per Caltrans requirements for new construction projects, according to Caltrans HQ staff. The traffic signal plans utilize 3 and 4-inch conduits when they are not necessary. Caltrans has a 26 percent conduit fill requirement for new construction projects. There are many instances in the plans where the conduit meets a fill requirement in the range of 5-10 percent. If the correct conduit fill requirements are used, the cost will be significantly reduced.^v Revisit the contractor's estimate for adding conduit to the current construction project to verify that it was not also based on conduit that is larger than necessary for the application.
5. The traffic controller cabinet selected for signalized intersections throughout the project may be excessive and unnecessary. The plans call for a 342LX traffic controller cabinet, and in many locations, there is not sufficient right-of-way for installation of the 342LX. For example, at the intersection of Tahoe Keys Blvd., the cabinet cannot be installed and meet the requirements for pedestrian accessibility. The project could instead use the type 332 cabinet, reducing project cost and making it feasible to install within the right-of-way without diminishing pedestrian travel.^{vi} These cost savings could be used to implement additional lighting recommendations for the project.

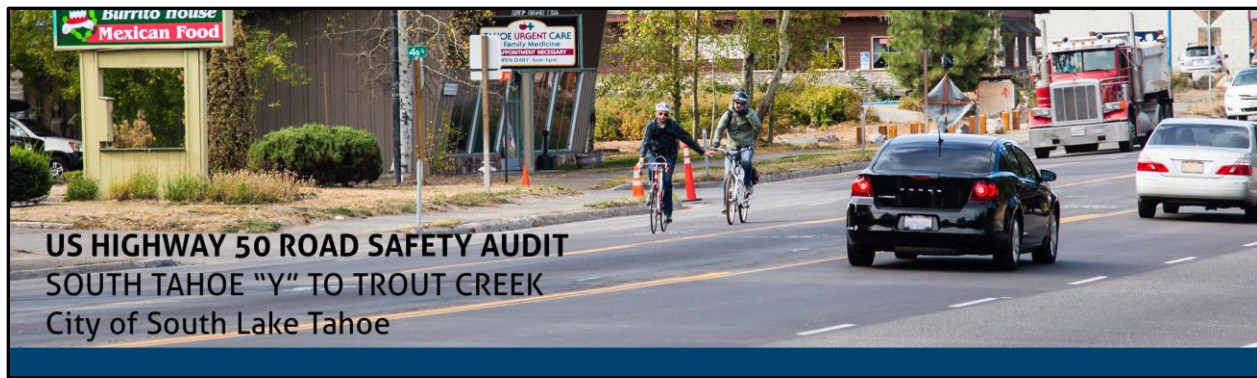
Locations for Improvement within Project Area:

The dark area between Tahoe Keys Boulevard and Lodi Avenue is approximately 2,600 feet long. It is recommended that this segment be split in two, feeding one lighting circuit from Tahoe Keys Boulevard and the other from Lodi Avenue to split the electrical load. This would require power for about 1,300 feet of roadway coverage from each service cabinet. At an electrolier spacing of 150 feet for a conventional highway, eight or nine fixtures would be installed at equal spacing from each intersection along U.S. Highway 50 on each side of the roadway. These electroliers on either side of the road can be installed opposite of each other, or they can be alternated for maximum visual effect.^{vii} This same approach may be used in the dark area east of Rubicon Trail. Depending on where the lights are being installed and for which purpose, a variety of fixtures including the City standard, Caltrans standard, and pedestrian bollard style lighting may be used.



Implementation Next Steps:

Decision-makers from both the City of South Lake Tahoe and Caltrans have not yet found a suitable agreement related to lighting, preventing installation of lighting that would be a critical corridor element to improve safety. The recommendations on the following page provide options for moving forward.



1. Reconsider Maintenance Responsibility: The City could reconsider accepting responsibility for the roadside. They would be accepting a roadside with newly constructed features, including sidewalk, walls, and fencing, that would require little maintenance for an extended time. During that time, the City could identify and implement a funding stream to perform future maintenance. Having ownership of the roadside features would also accomplish other City goals, such as having more control over developers plans along the roadside, location of driveways, continuity of trails and sidewalks, and aesthetic features that will enhance their community.
2. Revisit Conduit Estimate: The contractor's estimate for installing conduit as part of a change order is unreasonable - \$1.6 million was quoted during the RSA. Caltrans should revisit that estimate with the contractor, asking them to substantiate the numbers provided and further negotiate. If negotiation of a better price fails, Caltrans could instruct the contractor to install the conduit under force account procedures for location phases 2 and 3.
3. Maintenance Funded Project: Caltrans District 3 Maintenance will be receiving three \$461 million allocations over the next three years from SB1. These funds should be requested to help fund the installation of LED light fixtures/electroliers.^{viii}

ⁱ Rea, Mark S., John D. Bullough, Eric T. Donnell, et al; Review of the Safety Benefits and Other Effects of Roadway Lighting, TRB, 2009, p. 1. http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP05-19_LitReview.pdf

ⁱⁱ Pedestrian and Bicycle Information Center, Safe Routes to School Guide, 2015.

<http://guide.saferoutesinfo.org/engineering/sidewalks.cfm#lighting>

ⁱⁱⁱ Virginia Tech Transportation Institute, Information Report on Lighting Design for Midblock Crosswalks, FHWA, 2008. <https://www.fhwa.dot.gov/publications/research/safety/08053/>

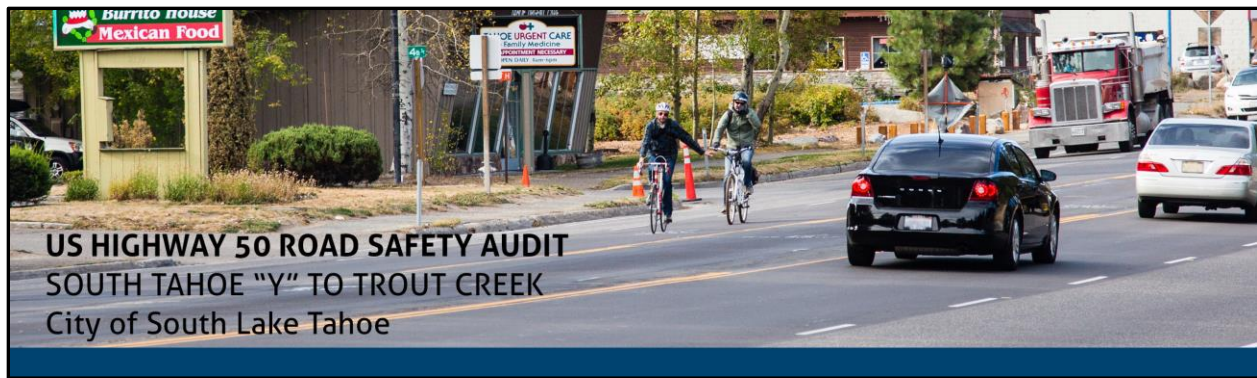
^{iv} Discussion with Federico Hormozi, PE, Chief, ITS Engineering and Support Branch, Caltrans, October 19, 2017.

^v Federico Hormozi, Chief, Caltrans ITS Engineering & Support Branch

^{vi} Federico Hormozi, Chief, Caltrans ITS Engineering & Support Branch

^{vii} Federico Hormozi, Chief, Caltrans ITS Engineering & Support Branch

^{viii} Federico Hormozi, Chief, Caltrans ITS Engineering & Support Branch



TRANSIT STOP LOCATIONS RELATIVE TO PEDESTRIAN CROSSINGS

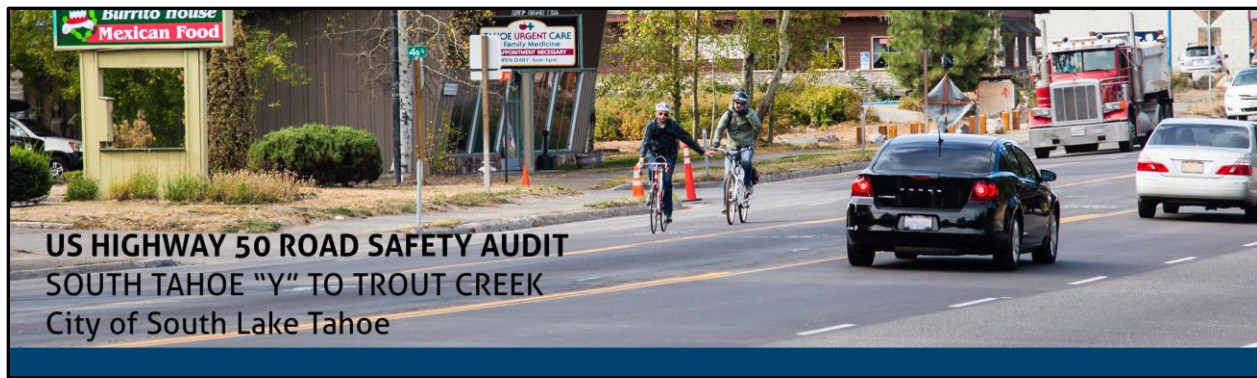
Issue Statement:

Every transit stop creates a desired place to cross for pedestrian travel. All passengers walking to a bus stop from the surrounding area will at some point need to cross the street, either to reach the bus on the outbound trip or when they disembark on the return trip. A pedestrian may legally cross U.S. Highway 50 anywhere within the project because of the numerous unsignalized intersections. If pedestrians aren't at an intersection crosswalk, which in many cases are unmarked within the project area, the pedestrian is expected to yield to motor vehicles.¹ If the bus stop is not near a marked or signalized pedestrian crossing, the placement of the bus stop will encourage potentially less-safe mid-block crossings, especially because there are so many destinations along the corridor, such as shopping, hotels, and restaurants.



State of the Practice:

Mid-block bus stops may be necessary and beneficial in some instances, but also present challenges. They are most appealing on a long block in which pedestrians cannot be expected to walk a long way to reach a bus stop or in places where a midblock destination will attract desired foot traffic. Mid-block bus stops and crossings minimize the number of conflict points for pedestrians - because traffic will be coming from only one direction - but vehicle speeds are often much higher, and drivers are not expecting the crossing to occur.



According to recent data, 72 percent of pedestrian fatalities in 2015 occurred at non-intersection locations nationwide.ⁱⁱ Mid-block bus stops should include a safe way for pedestrians to cross the street and be as close to the bus stop as possible. Ultimately, bus stops need to be in places where people want to go—near businesses, shopping, amenities, and housing. Care should be taken to minimize walking distances for pedestrians to reduce exposure.ⁱⁱⁱ

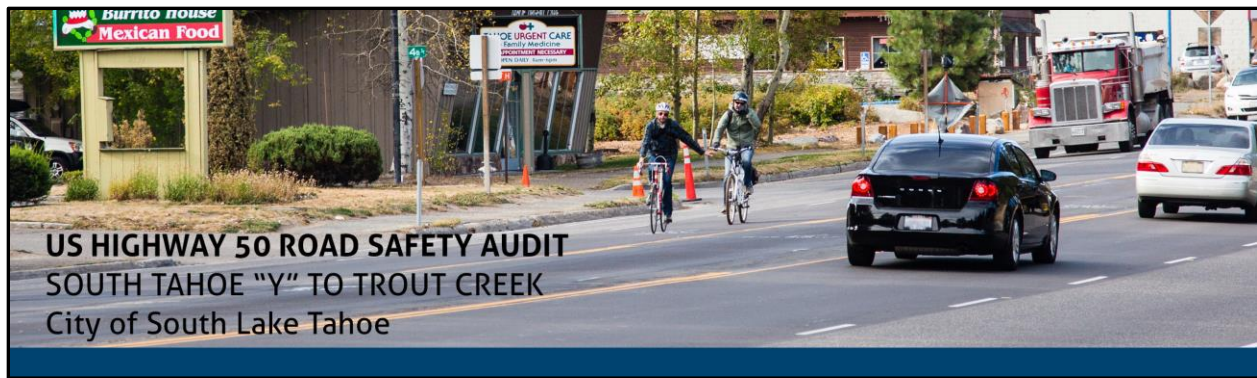
Recommendations:

1. **Update Bus Stop Locations:** Adjust mid-block bus stops to be near controlled pedestrian crossings, which in this case is near all the signalized intersections or a new controlled mid-block crossing (i.e. Pedestrian Hybrid Beacon or Pedestrian Signal).

Locations for Improvement within Project Area:

*Note—These bus stops are discussed in “Mid-Block Crossings section.”

| Location | Features | Recommendations |
|---------------|--|--|
| 112+97 EB | Bus stop is 300' from the nearest marked crossing to the west at 3 rd Street and 700' from the nearest marked crossing to the east Tahoe Keys Blvd. | Consider moving the bus stop closer to 3 rd Street. |
| 123+46 EB* | Bus stop is 200' from the nearest marked crossing to the west at Tahoe Keys Blvd. and 2400' from the nearest marked crossing to the east. | Moving the bus stop closer to Tahoe Keys Blvd. would interfere with driveways. Consider establishing a pedestrian crossing at Grocery Outlet/Motel 6. |
| 127+44 WB* | Bus stop is 1700' from the nearest marked crossing to the west at Tahoe Keys Blvd. and 2100' from the nearest marked crossing to the east at Lodi Ave. | Consider establishing a pedestrian crossing at Grocery Outlet/Motel 6 and moving the bus stop closer to this crossing. Consolidate with the bus stop at 138+00 WB. |
| 130+70 EB* | Bus stop is 900' from the nearest marked crossing to the west at Tahoe Keys Blvd. and 1800' from the nearest marked crossing to the east at Lodi Ave. The bus pull-out for this stop is too narrow and is recommended for in-lane operation. | Consider establishing a pedestrian crossing at Grocery Outlet/Motel 6 and moving the bus stop closer to this crossing. |
| 138+22 WB* | Bus stop is 2700' from the nearest marked crossing to the west at Tahoe Keys Blvd. and 1000' from the nearest marked crossing to the east at Lodi Ave. | Consider establishing a pedestrian crossing at Grocery Outlet/Motel 6 and moving the bus stop closer to this crossing. Consolidate with the bus stop at 128+00 WB |
| 151+78 WB | It is unclear from the plans if this bus stop remains near Lodi Ave. at 149+00 or moves to 151+78 where the curb is being tapered. The width outside of the motor vehicle lane at 149+00 is 10.7'. | Keep bus stop near the Lodi Ave. intersection where there is a pedestrian crossing. |
| 154+06 EB | Bus stop is 500' from the nearest marked crossing to the west at Lodi Ave. and 400' from the nearest marked crossing to the east at Sierra Blvd. The bus pull-out for this stop is too narrow and is recommended for in-lane operation. | Consider moving the bus stop closer to Sierra Blvd. |



Project Location Recommendations Continued:

| | | |
|--------------|--|---|
| 161+09 WB | Bus stop is 200' from the nearest marked crossing to the west at Sierra Blvd. and 600' from the nearest marked crossing to the east at Rubicon Trail. | Consider moving the bus stop closer to Sierra Blvd. at the far side of the intersection at 157+50 WB where there are no driveway conflicts. |
| 164+70 EB | Bus stop is 600' from the nearest marked crossing to the west at Sierra Blvd. and 300' from the nearest marked crossing to the east at Rubicon Trail. | Consider moving the bus stop closer to Rubicon Trail at either 167+00 EB or 168+20 EB |
| 170+60 WB | Bus stop is located at the right-turn lane for Brockway Ave. Bus stop is 200' from the nearest marked crossing to the west at Rubicon Trail and 3000' from the nearest marked crossing to the east at Al Tahoe Blvd. | Consider establishing a pedestrian crossing near Taco Bell/Whiskey Dicks and relocating the bus stop to this location. |

Implementation Next Steps:

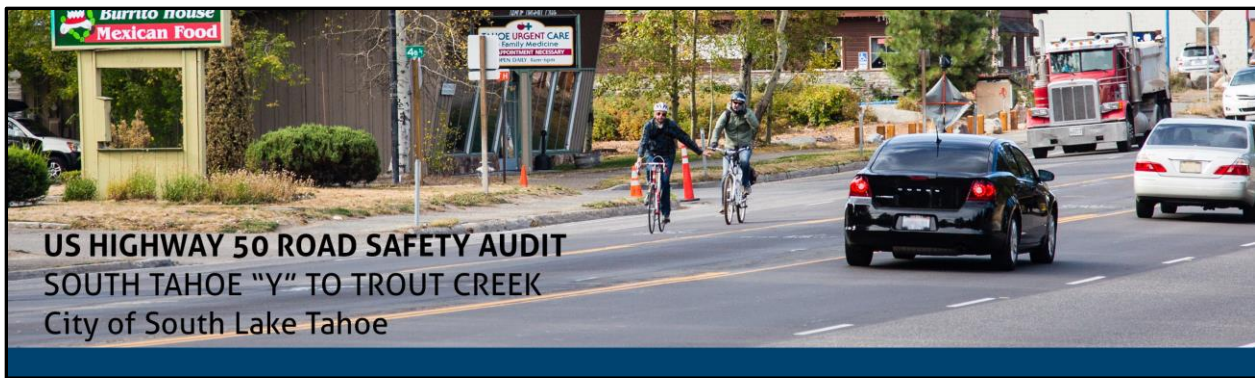
1. Coordinate with Tahoe Transportation District: There should be coordination between Caltrans, the City of South Lake Tahoe, and the Tahoe Transportation District to discuss location of bus stops.
2. Produce Change Order for Current Project: Relocation of bus stops can be added to the current projects through change order.
3. Analyze Mid-Block Crossing Locations: Caltrans, City of South Lake Tahoe, and Tahoe Regional Planning Agency should commence studies for mid-block pedestrian crossings at Grocery Outlet/Motel 6 and Taco Bell/Whiskey Dicks locations, as discussed in "Mid-Block Crossings."

ⁱ California Vehicle Code Section 21955.

ⁱⁱ National Highway Traffic Safety Administration, 2017

ⁱⁱⁱ Transportation Research & Education Center at Portland University, FTA Report No. 0111, *Manual on Pedestrian and Bicycle Connections to Transit*, Federal Transit Administration, 2017.

<https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/research-innovation/64496/ftareportno0111.pdf>



US HIGHWAY 50 ROAD SAFETY AUDIT SOUTH TAHOE "Y" TO TROUT CREEK City of South Lake Tahoe

TRANSIT STOP DESIGN

Issue Statement:

Many of the transit stop pull-outs designed for the U.S. Highway 50 corridor are too narrow for buses to load and unload passengers without partially blocking the motor vehicle lane and entirely blocking the bicycle lane. With the motor vehicle lane partially blocked, it is unclear to drivers whether they are meant to pass within the lane or to change lanes. Meanwhile, bicyclists approaching the bus from behind may choose to maneuver around the bus in the motor vehicle lane. With the distraction of the bus and confusion already imposed upon drivers with the blocked lane, drivers are likely to overlook the inconspicuously-sized bicyclist while maneuvering around the bus. Bus stops are a conflict point for bicyclists, where bicyclists are at greater risk of being in a crash with a bus that is crossing or blocking the bike lane, or with a motor vehicle when the bicyclist maneuvers around the bus.

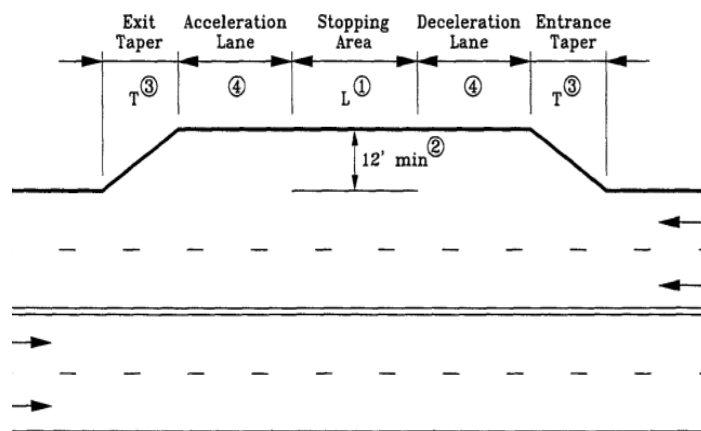


Existing bus pull-out on US 50

State of the Practices:

Bus stops are designed to either operate with the bus stopping in the travel lane or with the bus pulling entirely out of the travel lane. In-lane bus stops provide easy access for bus drivers and minimal delay for the bus because it does not need to wait for traffic to pull back into the vehicle lane. However, in-lane operation does increase the number of lane changes by motor vehicles and thus, the risk that more sideswipe and rear-end crashes will occur. Bus pull-outs, where the bus is not obstructing the travel lane, minimizes delay for other motor vehicles. However, pull-outs can make it difficult for the bus to re-enter traffic and delay the bus.ⁱ

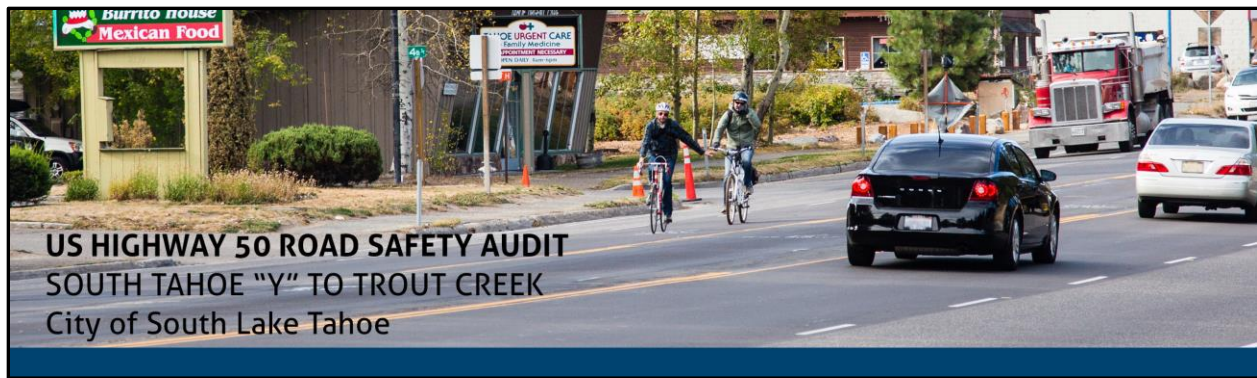
The proper design of a bus bay includes, at a minimum, an entrance taper, a stopping area, and an exit taper, as was done further to the east on U.S. Highway 50. Although deceleration and acceleration lanes are recommended, they may be omitted. The stopping area is 50 feet for a standard 40-foot bus. The recommended bus bay width for a roadway with speeds above 30 mph roadway is 12 feet, not including the gutter. An entrance taper of a ratio of 5-to-1 is desirable, and the exit taper should not be sharper than 3-to-1.ⁱⁱ



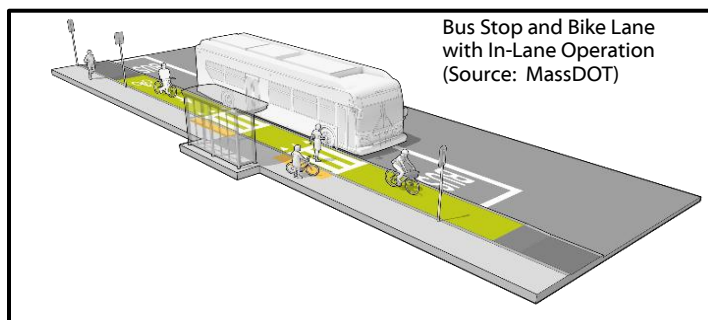
Bus Pull-Out (Source: TRCP-19)

The recommended bus bay width for a roadway with speeds above 30 mph roadway is 12 feet, not including the gutter. An entrance taper of a ratio of 5-to-1 is desirable, and the exit taper should not be sharper than 3-to-1.ⁱⁱ

The conflict points at the bus stop between the bus, bus passengers who are loading and unloading, and bicyclists should be clearly visible. There are two general design approaches: stopping the bus in the motor vehicle lane or stopping the bus at the curb.

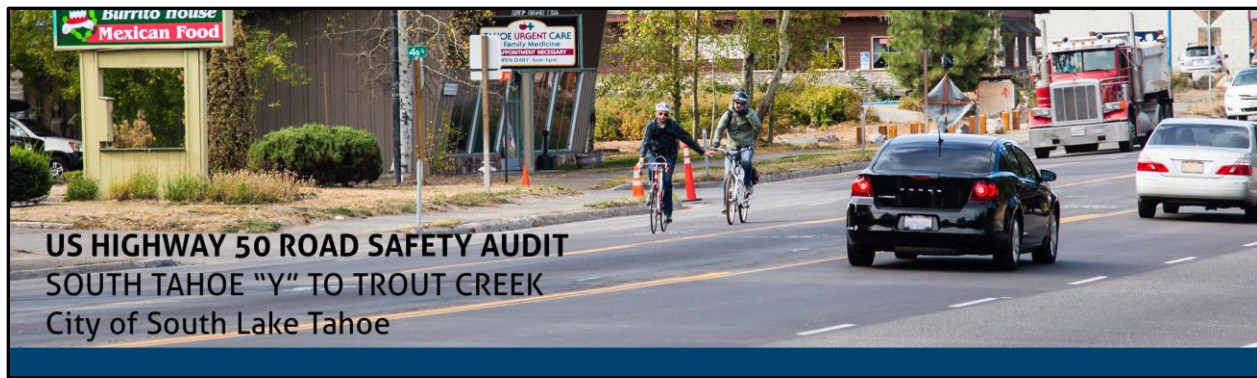


1. Bus Stopped in Vehicle Lane: When the bus stops in the vehicle lane, the bike lane remains unobstructed. The bike lane needs to be raised to the level of the sidewalk where bus passengers are loading and unloading to maintain accessibility. Pavement markings and signs should be used to highlight the conflict zone between bicyclists and pedestrians and to encourage the bicyclists to yield to pedestrians.ⁱⁱⁱ
2. Bus Stopped at Curb: When the bus stops at the curb, the bus is crossing—and may be obstructing—the bike lane. Pavement markings should be used to highlight the conflict zone between the bus and the bicyclist, using dashed lane lines, bike lane symbols, and shared-lane markings. At these locations, bicyclists may choose to pass a stopped bus by moving into the motor vehicle lane.

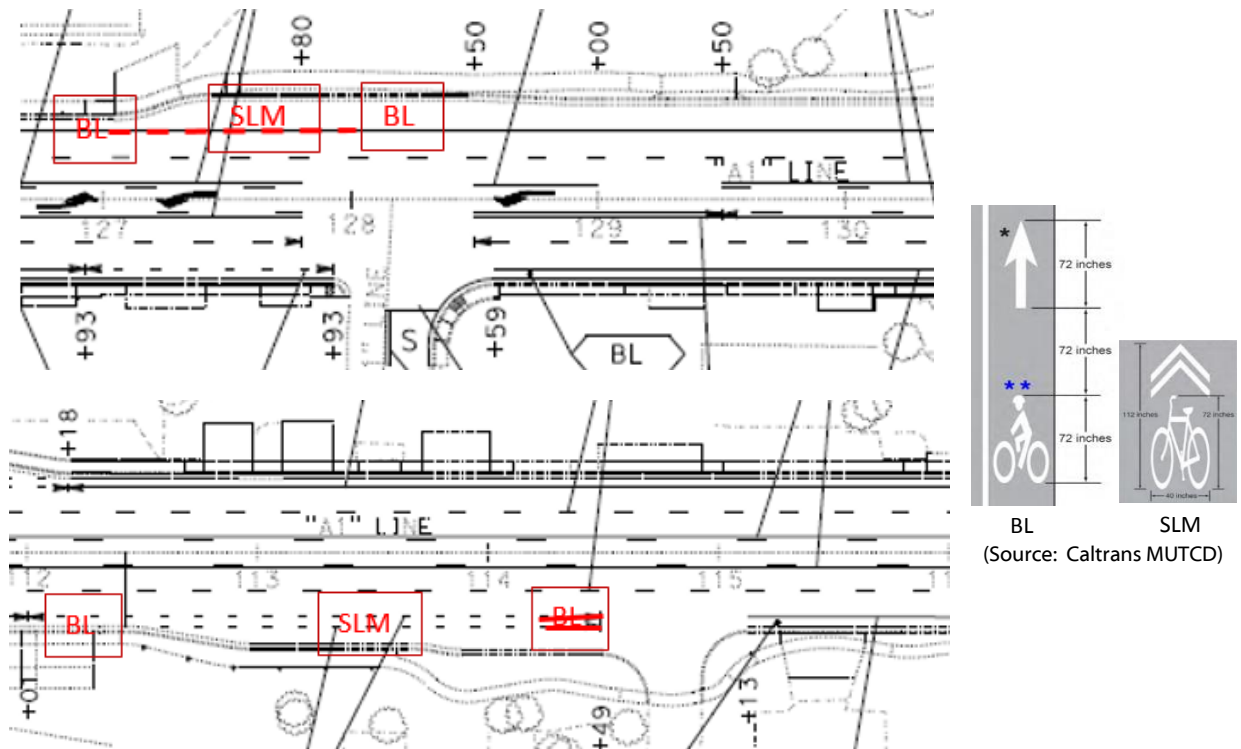


Recommendations:

1. Update Bus Pull-Out Configurations in Project Plans: As currently planned, all bus pull-outs in the U.S. Highway 50 project will obstruct the bicycle lane. In the cases where the stopped bus will also obstruct the motor vehicle lane, the pull-out should be removed and changed to in-lane operation. With the removal of the pull-outs, that space can be used to improve the waiting and loading area for transit users.
2. Update Pavement Markings in Project Plans: Pavement markings at the bus stops should be enhanced to highlight the conflict area between the buses and bicyclists.
 - a. Add a bike lane symbol just in advance of the bus entrance taper or just prior to stopping area for in-lane operation.
 - b. Add a bike lane symbol (BL) just after the bus exit taper or just after the stopping area for in-lane operation.
 - c. Use dashed lines on both sides of the bike lane along the length of the bus tapers and stopping area and place a shared-lane marking (SLM) in the bike lane in the conflict area.



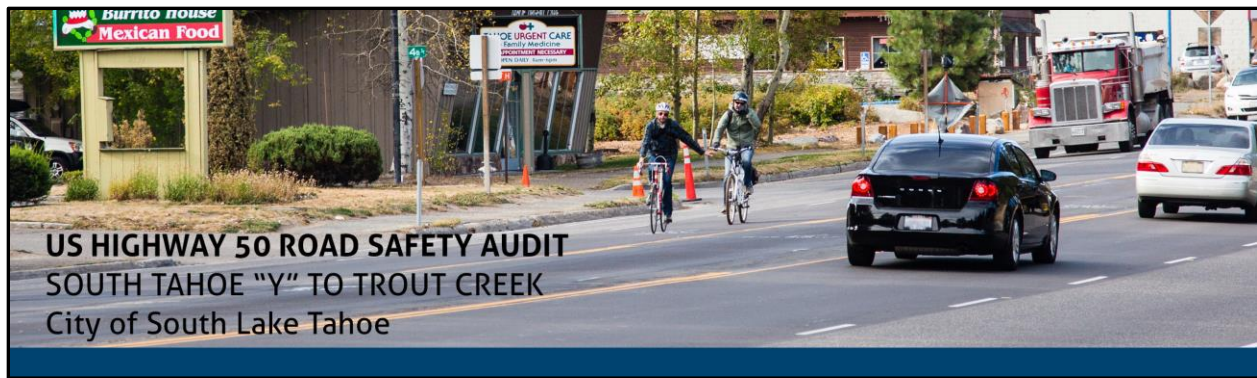
Examples of Pavement Markings Recommended at Bus Stops



Locations for Improvement within Project Area:

The widths in the following table indicate the width of the bus pull-outs as planned. Those pull-out widths combined with the width of the four-foot bike lane and one-foot gutter pan will need to provide enough space for the bus to stop without encroaching in the motor vehicle lane. Since standard buses are 10.5-feet wide, 5.5 feet is the narrowest that a pull-out should be. Motor vehicles may slow, or shy away from the stopped bus, but will be able to remain in their lane to pass. It is recommended that bus stops with bus pullouts less than 5.5 feet remain as stops in the vehicle lane closest to the curb. The additional width shown in the plans could be used for wider sidewalk and landing area for transit riders. Enhanced pavement markings are recommended for all bus stops within the project limits, including those that do not have pull-outs.

| Bus Pull-outs to Remove | | Bus Pull-Outs to Remain | | Other Bus Stops |
|-------------------------|-----------|-------------------------|------------|-----------------|
| 130+70 EB | 4.6' wide | 112+97 EB | 7.5' wide | 164+70 EB |
| 154+06 EB | 3.9' wide | 123+46 EB | 5.5' wide | |
| | | 127+44 WB | 8' wide | |
| | | 138+22 WB | 8' wide | |
| | | 151+78 WB | 8' wide | |
| | | 161+09 WB | 5.5' wide | |
| | | 170+60 WB | 11.4' wide | |
| | | 173+22 EB | 7' wide | |
| | | 180+65 WB | 5.3' wide | |



Implementation Next Steps:

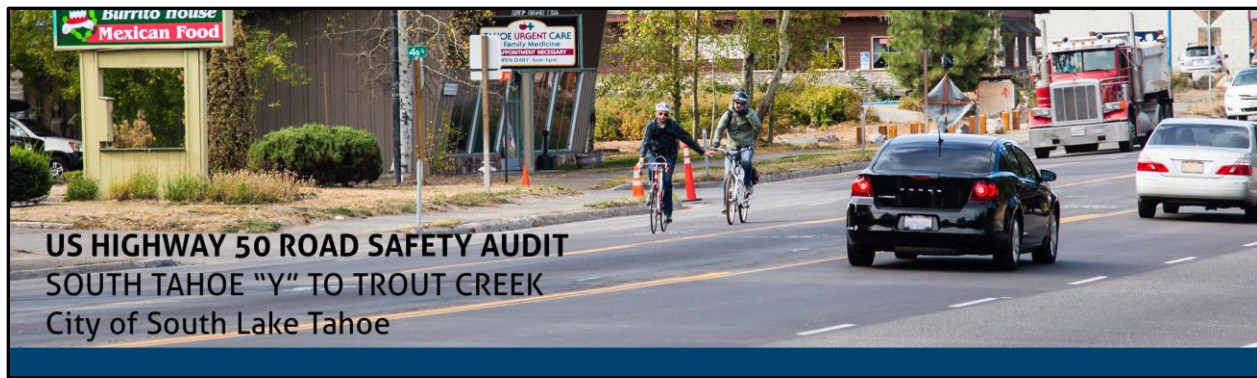
1. Coordination with Tahoe Transportation District: Operators from the transit agency have stated a preference for having bus pull-outs during the RSA. There should be coordination with the Tahoe Transportation District to discuss the bus pull-outs recommended for reconfiguration.
2. Produce Change Order to Current Project: Modification to the bus stops and changes to the pavement markings can be added to the current project through a change order.

ⁱ Transportation Research & Education Center at Portland University, FTA Report No. 0111, *Manual on Pedestrian and Bicycle Connections to Transit*, Federal Transit Administration, 2017.

<https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/research-innovation/64496/ftareportno0111.pdf>

ⁱⁱ Texas Transportation Institute, TRCP Report 19, *Guidelines for the Location and Design of Bus Stops*, National Academy Press, 1996. http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_19-a.pdf

ⁱⁱⁱ Massachusetts Department of Transportation, *Separated Bike Lane Planning and Design Guide*, 2016. <http://www.massdot.state.ma.us/highway/DoingBusinessWithUs/ManualsPublicationsForms/SeparatedBikeLanePlanningDesignGuide.aspx>

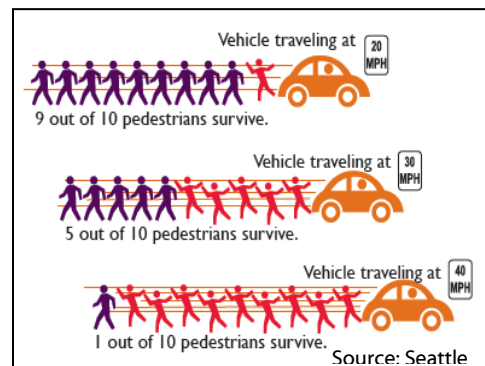


SPEED MANAGEMENT

Issue Statement:

Speed, difference between drivers' speeds, and pure physics are major contributors to crashes that result in injuries. Count data conducted by Caltrans and TRPA estimates that dozens of people per day are walking and biking within the project area. Within the limits of this U.S. Highway 50 project, from 2006-2016, there were 116 injury crashes - three fatal, 10 severe injuries, and 31 visible injuries. In 2012, the posted speed limit was changed from 35mph to 40mph after Caltrans conducted a speed study with the 85th percentile speed methodology. Over this same period, three pedestrians were killed in 2011, 2013, and 2016. Numerous business owners, residents, organizations, and governmental agencies, including the City of South Lake Tahoe and TRPA, opposed the increase in speed limits.

Pedestrians and bicyclists have a much higher risk of being injured or killed in a crash on higher speed roadways, which is a roadway with speeds above 35 mph. Studies have shown that when a vehicle is traveling at 40 mph there is only a 1 and 10 chance of a pedestrian surviving the crash. The posted speed in the project area is 40 mph. Of the 14 pedestrian injury crashes in the project limits nearly all - 11 of 14 - of them occurred at night. In addition to the crash data, there are other roadway features that are critical when discussing speed limits and risks. Within the limits of the 2-mile project, there are five signalized intersections, 13 minor stop sign controlled side roadways, and nearly 100 commercial driveways. With every driveway, there are conflicts between all modes and left turns across four lanes becomes very challenging.

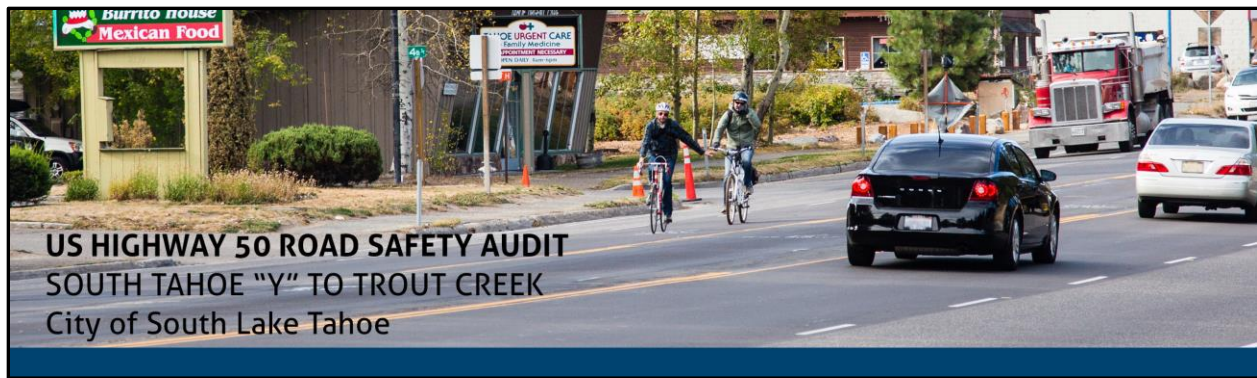


Changing the speed limit must be done in accordance with the California Vehicle Code (CVC) and CA MUTCDⁱ and a partnership with California Highway Patrol. Per the forward in the CA MUTCD it "is not intended to be a substitute for engineering knowledge, experience or judgement." The CVC requires the consideration of the following when setting speed limits; prevailing speeds as determined by traffic engineering measurements (85 percentile), accident records, and highway, traffic, and roadside conditions not readily apparent to the driver, such as vulnerable user activity and access points. Design guidance including the CA MUTCD request the use of engineering judgement to equitably consider the appropriate speeds for the context and users of the roadway.

Noteworthy Practices:



With the recent Towards Zero Deaths and Vision Zero efforts, transportation and safety professionals are re-visiting the practices of setting speed limits and how agencies consider speed in their projects. Raising speed limits leads to more deaths. Research shows that when speed limits are raised, vehicle speeds increase beyond the limit, and fatal crashes increase. Research indicates that crash risk is lowest for motorists driving near the *average speed* of traffic and increases rapidly for motorists traveling much faster than averageⁱⁱ. The common practice of raising the speed limit to match the 85th percentile speed may lead to higher operating speedⁱⁱⁱ. A higher 85th percentile speed leads to an undesirable cycle of speed escalation and reduced safety.^{iv}



1. **Speed Management Program:** A Speed Management Program is a strategy that addresses the concern of unlawful and undesirable speeds within a jurisdiction or along a corridor. Speed management is necessary to achieve an optimal multimodal transportation environment that will support the local land use and transportation contexts. A speed management program allows agencies to look at their roadways and assess if there is a disconnect between the design features, the users, and the adjacent land use. Considerations for speed management include but are not limited to:

- ✓ Roadside development
- ✓ Crashes
- ✓ Road characteristics
- ✓ Pedestrian activity
- ✓ Bicycle activity
- ✓ Intersection control/operations
- ✓ Prevailing speed data
- ✓ Parking
- ✓ Access/Driveways

Benefits of a Speed Management Program^v include reduction in injury crashes resulting from higher speeds, greater potential for motorists to avoid crashes, enhanced safety for pedestrians and bicyclists, education of driving population, and enhanced community safety culture. Some speed management techniques include road diets, coordinated signals, automated speed enforcement, access control, reducing unwarranted high posted speeds, etc.

2. **Target Speed for Roadways^{vi}:** The objective of the target speed approach is to establish the design speed at the desired operating speed. The design speed selection is derived from all other design controls such as context characteristics, modal priorities, access control, performance, and transportation and land use context characteristics. Low target speed can be defined at 35 mph and below and is ideal for roadways with pedestrian and bicycle modal priorities, intermodal connections, frequent transit stops, moderate to high density of intersections, and access densities. The Washington State DOT design guidance includes Target Speed as a driving factor in roadway design. The process illustrated to the right shows the connections between design controls. The Pennsylvania DOT and NJ DOT are also changing their guidance for designing roadways that results in consistent operating speeds based on context.^{vii}

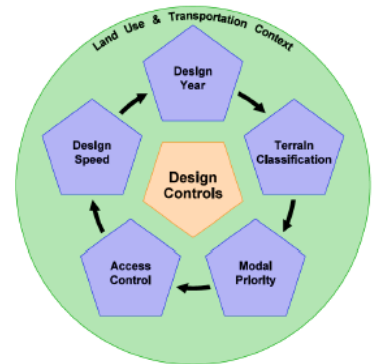
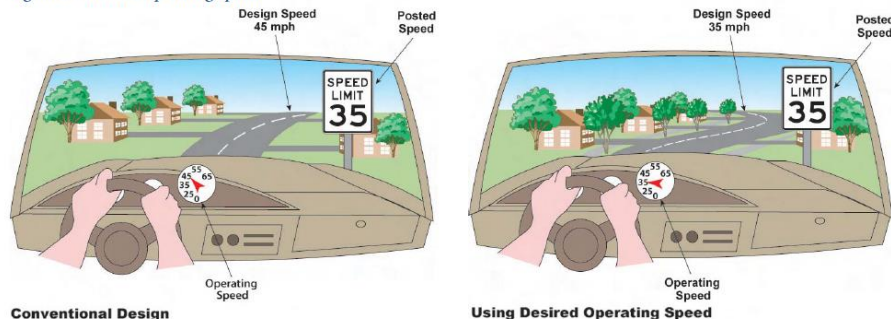
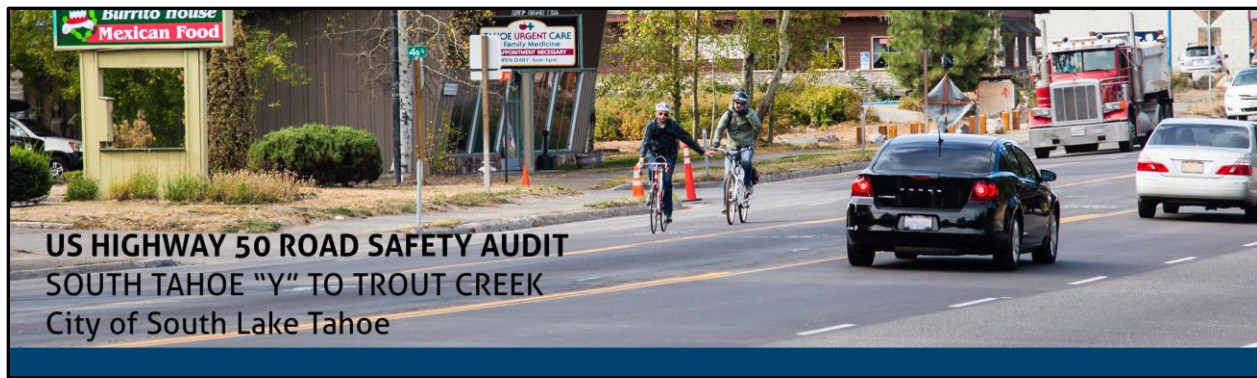


Figure 6.3 Desired Operating Speed





The Caltrans Complete Streets Implementation Action Plan 2.0 and Deputy Directive 64-R2^{viii} also calls out the importance of context sensitive solutions that address the needs of all users during project planning, design, construction, and operations and maintenance. This includes designing roadways to improve safety which may require specific design elements that naturally reduce speeds.

Recommendations for Implementation:

1. **Speed Study:** At the conclusion of the U.S. Highway 50 project construction project, and after the appropriate adjustment period which per Caltrans is 1 -2 years, a speed study will be conducted using state of the practice methodologies and following CVC requirements for setting rational speed limits. A holistic approach employing the latest research and guidance on speed, risk of crashes, and roadway context such as the Target Speed should be used. This should be a data driven and context appropriate study to achieve an appropriate posted speed. This would need to be led by Caltrans as the roadway owners, however input from law enforcement and the City is critical. The speed study should include qualitative and quantitative data and analysis.
2. **Speed Management Program:** Initiate a speed management program that engages professionals from engineering, law enforcement, emergency services, public health, etc. This program can help reduce the risks associated with speed for all users. This can be done City wide and include state, county, and local roadways. The road diet pilot on Al Tahoe Blvd. in 2017 and the proposed design for Sierra Blvd. are two great examples of how changing lane widths and narrowing intersections through bulb-outs alter the roadway environment to create a self-enforcing roadway for all users.

Locations for Improvement within Project Area: Project-wide

Implementation Next Steps:

1. **Speed Management Program:** Create a speed management program that includes the use of the target speed methodology for U.S. Highway 50 and major side streets and infrastructure designs that could be used to accomplish desired speeds.
2. **Speed Study:** With the conclusion of the construction project, it is possible that an additional speed study will be conducted along U.S. Highway 50. It is recommended that any speed studies consider the latest research and guidance on setting speed limits from NTSB and USDOT rather than relying solely on the outdated 85th percentile speeds for determining the prudent posted speed for a roadway with multiple users and functions. The speed management program should assist with this effort and be created before the speed study if possible.

ⁱ California Manual on Uniform Traffic Control Devices

ⁱⁱ Insurance Institute for Highway Safety, <http://www.iihs.org/iihs/topics/t/speed/topicoverview>

ⁱⁱⁱ National Transportation Safety Board, <https://www.nts.gov/safety/safety-studies/Documents/SS1701.pdf>

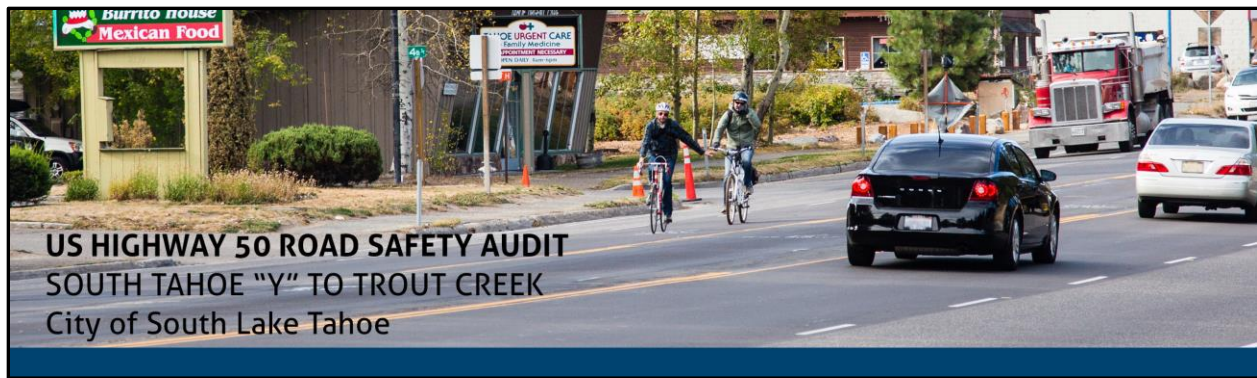
^{iv} <http://visionzeronetwork.org/national-study-safety-over-speed/>

^v https://safety.fhwa.dot.gov/local_rural/training/fhwasa010413spmgmt/

^{vi} Washington State DOT Target Speed Guidance, <http://www.wsdot.wa.gov/publications/manuals/fulltext/M22-01/1103.pdf>

^{vii} New Jersey DOT, <http://www.state.nj.us/transportation/community/mobility/pdf/smarttransportationguidebook2008.pdf>

^{viii} Caltrans, http://www.dot.ca.gov/hq/tpp/offices/ocp/docs/CSIAP2_rpt.pdf



WINTER MAINTENANCE AND SNOW REMOVAL PLAN

Issue Statement:

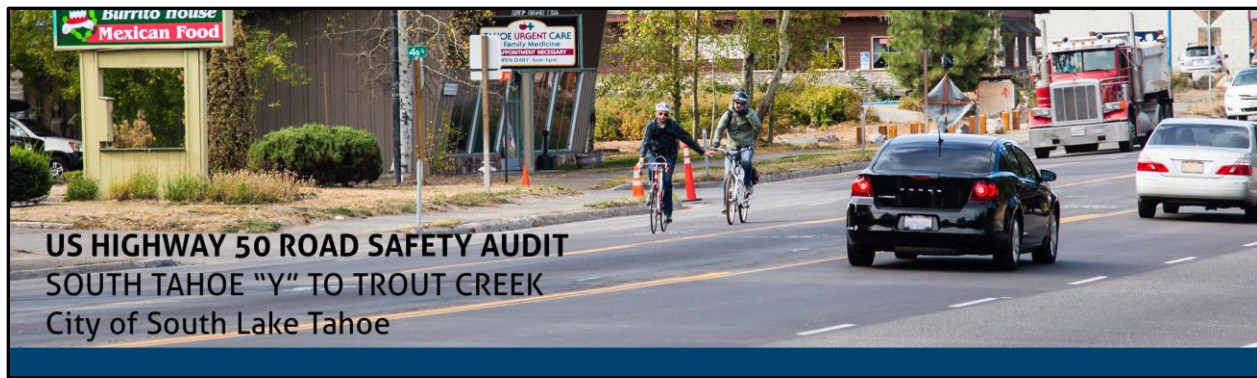
Snow removal in the Lake Tahoe Region is critical for safe and efficient movement of roadway users in the winter months. Winter operations and maintenance have impacts on roadway user safety, infrastructure design, economic vitality, multi-agency funding, and maintenance time and resources. In the City of South Lake Tahoe, Caltrans District 3 performs snow removal operations on U.S. Highway 50, while the City performs snow removal for all local streets and primary multi-use paths. Business owners are responsible for sidewalk snow removal. Although snow operations are operating at a high-level, there are improvements that may be possible through discussions and development of a City of South Lake snow removal plan and MOU with Caltrans.



Noteworthy Practices:

The table below outlines the key snow removal operations, issues associated with these operations or features, and noteworthy practices that could increase safety for all users through a few modifications to operations.

| Operations | Issues | Noteworthy Practices |
|--|--|--|
| Holding Snow in Two Way Left Turn Lane (TWLTL) | <ul style="list-style-type: none"> Lack of sight distance for any turning vehicle or pedestrian crossing the road Reduced left turn storage causes queuing in the through lane | <ul style="list-style-type: none"> Prioritize snow removal first for intersections and major access points Limit height of snow piles Provide time limit for removal |
| Sidewalk / Path Snow Removal | <ul style="list-style-type: none"> Pedestrian access and accessibility Users forced to walk in roadway | <ul style="list-style-type: none"> Order of operations - strategic storage locations Education of property owners/leases Pre-treatment Easement for winter storage in some areas to allow for connectivity |
| Plowing Near Raised Features | <ul style="list-style-type: none"> Damage to curb Modified operations where curbing is present | <ul style="list-style-type: none"> Delineation of raised features Curb designed for plowing (mountable/slope nose) Training operators on how to operate with new infrastructure |



Recommendations:

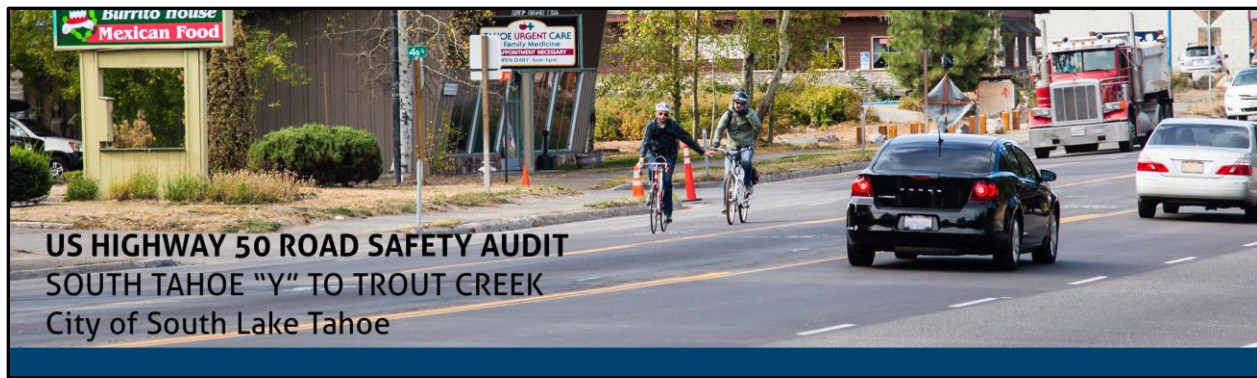
Revisiting the City of South Lake Tahoe snow removal plan for local streets, paths, and sidewalks as well as developing an MOU with Caltrans would provide an opportunity for a holistic approach that brings all operations up-to-date with current goals, infrastructure types, and resources. Based on the noteworthy practices listed above, recommendations for the City include:



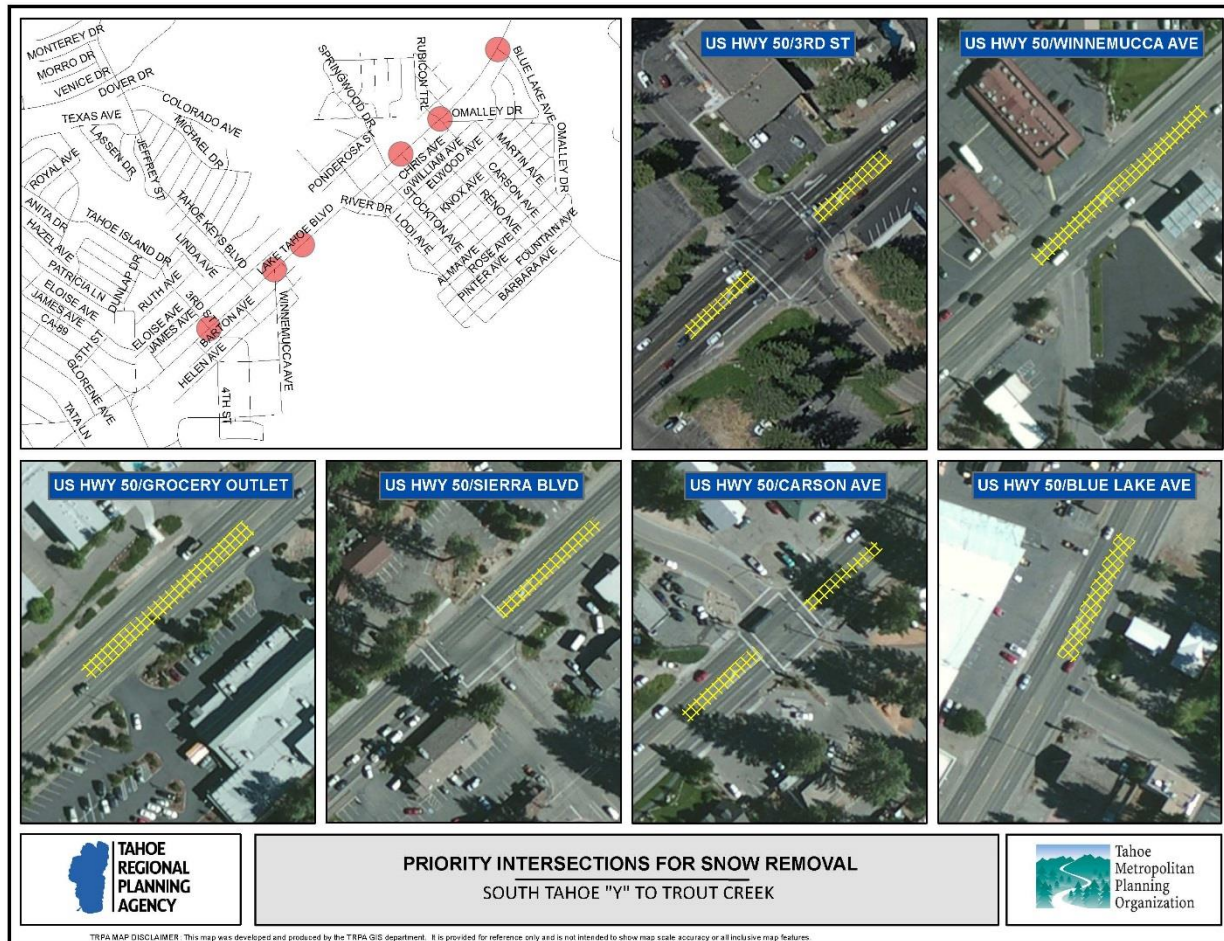
1. Use of TWLTL on U.S. Highway 50 for snow storage:
 - a. Critical left turn pockets at access points (intersections and driveways) should be identified and prioritized for removal out of the TWLTL to increase safety and access.
 - b. A time limit indicating how long snow may be held in the TWLTL after a storm event.
 - c. A height limit (or sloping shape) at the breaks in the snow should be put in place to increase sight distance.
2. Order of Operations: Which areas are plowed first and by whom should be clearly defined to reduce snow removal on active transportation facilities being impacted by roadway snow removal procedures.
3. Pre-Treatment: Paths and sidewalks can be pre-treated before a storm making snow removal easier and quicker for personnel and safer for users.
4. Curb Designs: Curbs should use best practices that allow plows to mount, roll, and avoid damage.
5. Training, Labor, and Funding: Resources that provide training of personnel on updated methods, allows personnel enough time, and provides the right equipment to remove snow safely should be clearly defined. New equipment may be necessary.

Locations for Improvement within Project Area:

1. Priority locations that should be identified/prioritized to enable increased sight distance, turning movements, and access include 3rd Street, Winnemucca Avenue, Driveway to Grocery Outlet, Sierra Boulevard, Carson Avenue, and Blue Lake Avenue. Please see map provided on the following page.
2. Order of Operations: With new sidewalks being constructed under this project, sidewalks along the entire project area should be maintained for year-round use and coordinated for snow removal post roadway snow removal to reduce impact from roadway operations.
3. Education for property owner/leases: The sidewalks will be new for some of the property owners, so a gentle reminder of the expectations and appropriate City codes should be shared.

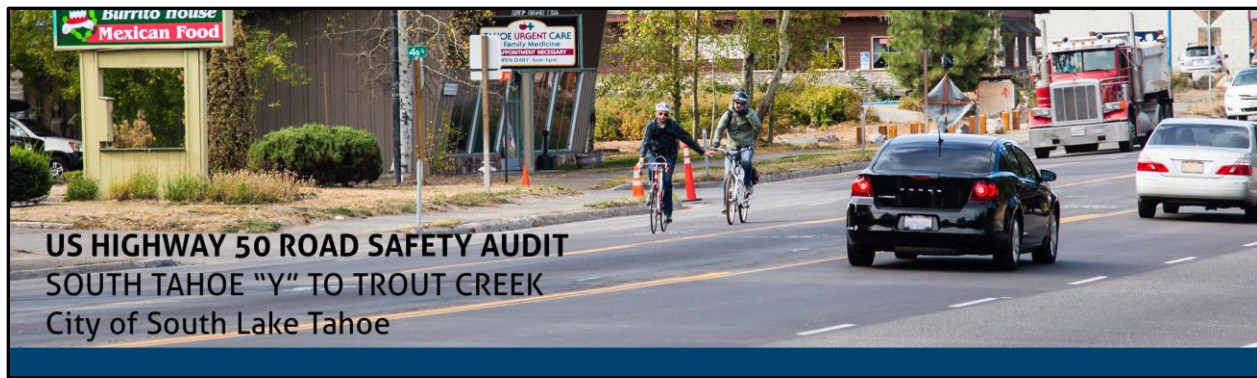


Map of Location Recommendations:



Implementation Next Steps:

1. **Update Agreement:** It is suggested that an updated agreement between Caltrans and the City be pursued for the upcoming winter and new practices can be reviewed and updated at the end of the season for the following years.
2. **Resources:** The update should identify the additional resources needed to increase the number of personnel employed and trained on new methods, and the new equipment needed to appropriately plow paths and in roadway infrastructure.
3. **Education:** Materials such as website, newspaper ads, and mailers should be handed out to the local property owners and lessees of the properties before winter.



Pedestrians and Bicyclists Accommodation in Work Zones

Issue Statement:

Work Zone safety and operations during construction for pedestrians and bicyclists is equally, if not more important than for motor vehicles. Pedestrians and bicyclists are the most vulnerable users of the roadway to the risks produced by work zone and impediments to travel. During the review of U.S. Highway 50, The section from the "Y" to Tahoe Keys Blvd. (Location 1) of the project was under construction. Temporary traffic control and detour routes for pedestrians and bicyclists though provided, were inadequate in many places.



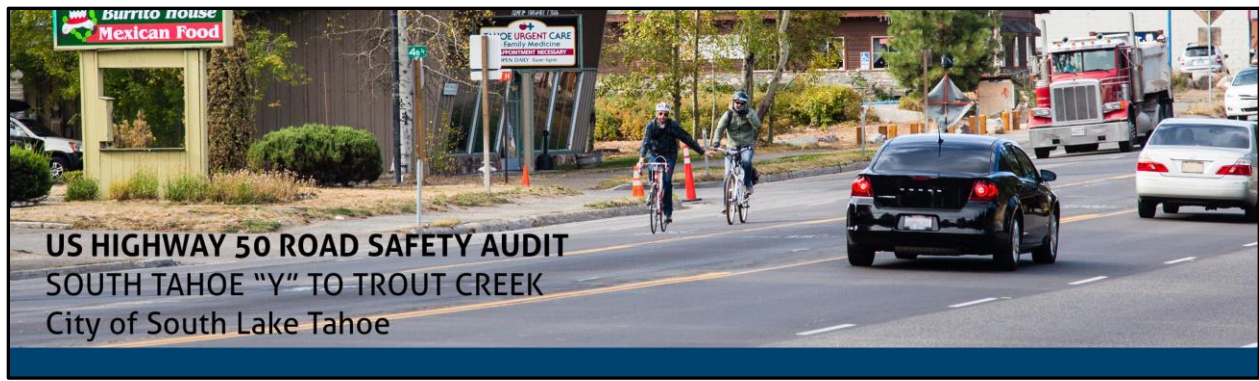
Width was reserved on one side of the road for two-way travel of bicyclists during certain times of the day when motor vehicle lanes were shifted or reduced. However, there were no markings or signs to indicate to unfamiliar drivers, unfamiliar bicyclists, or construction workers that this is a bike lane. Bicyclists traveling in this space against traffic will be at greater risk for crashes with turning vehicles at intersections where bicyclists will be coming from an unexpected direction. During evening hours when all lanes have been opened to vehicular traffic, the pavement surface near the curb line where bicyclists would ordinarily ride was not in suitable condition.



The closure of this sidewalk, pictured left, is inadequate to alert pedestrians with vision disabilities, who would then be at risk of falling. A pedestrian using a cane or walker has no accessible pathway around the work area.

The path to the temporary push button, pictured right, is loose and unstable. A pedestrian in a wheelchair could tip over or get stuck, and a pedestrian using a walker could fall.





US HIGHWAY 50 ROAD SAFETY AUDIT SOUTH TAHOE "Y" TO TROUT CREEK City of South Lake Tahoe

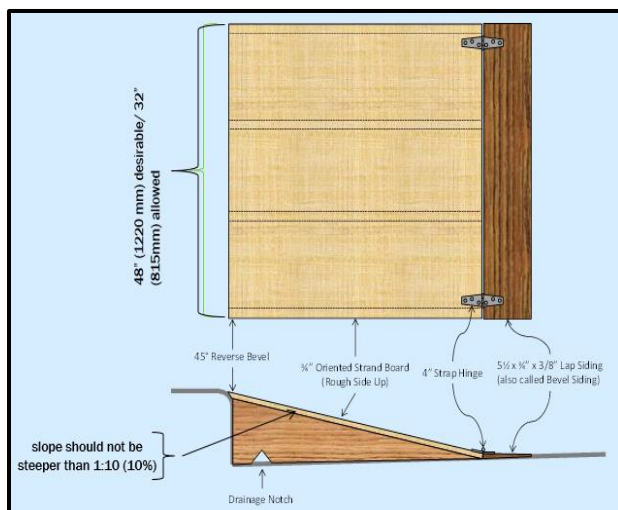
The sidewalk closure pictured left is not detectable to pedestrians with vision disabilities. The sidewalk closure begins at a location where there are no provisions for crossing the street. No information is provided about where to detour around the work zone.



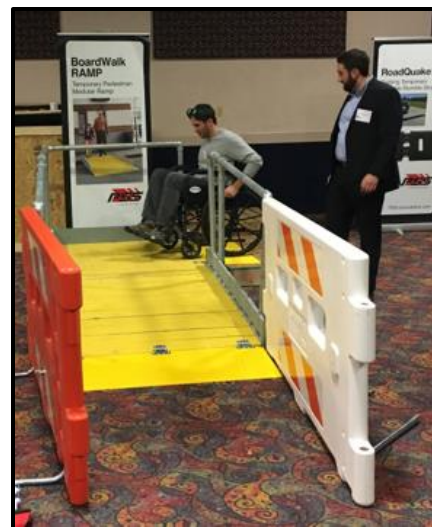
The sidewalk closure pictured right is also not detectable to pedestrians with vision disabilities. The sign directs pedestrians to cross at a location where there are no provisions for crossing the street.

Noteworthy Practices:

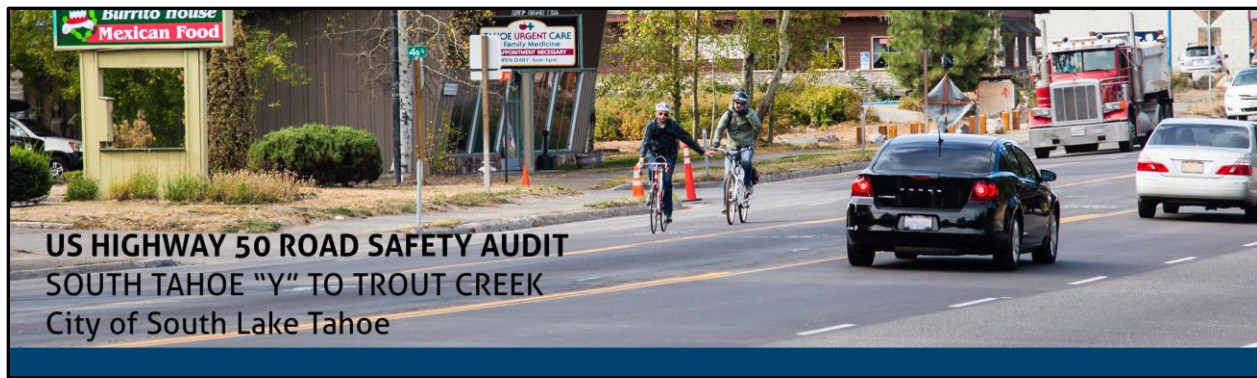
Bicyclists and pedestrians should be guided in a clear and positive manner while approaching and traversing temporary traffic control zones. Adequate warning, delineation, and channelization should be provided to assist in guiding all road users. Information, delineation, and traffic control devices that are usable by pedestrians with disabilities should be provided.ⁱ



Detail for a Temporary Curb Ramp Manufactured from Lumber



Example of a Temporary Ramp



Recommendations:

1. Avoid long, out-of-direction detours for pedestrians and bicyclists. Remember, they are out in the weather traveling under their own power and longer distances discourage active transportation.
2. When pedestrians are directed to the other side of the street, do so at a marked crossing location.
3. Provide signage to identify temporary bike lanes or to indicate that bicyclists are to share the lane with motor vehicle traffic.
4. Maintain a traversable surface for bikeways through the work zone—debris and poor pavement condition can be catastrophic to a bicyclist.
5. Use audible signs to alert pedestrians with vision disabilities that there is a sidewalk closure ahead and information on where to detour or cross the street.
6. Use detectable features at sidewalk closures to prevent pedestrians with vision disabilities from falling into the work area.
7. Use temporary curb ramps and stable surfaces to provide access around or through the work zone. Loose soil, unstable plywood, or other uneven surfaces will be an obstacle to those using a cane, walker, or wheelchair.
8. Place temporary traffic control devices that do not obstruct sidewalks or bike lanes.
9. Stockpile or store equipment and materials in a way that does not obstruct sidewalks or bike lanes.ⁱⁱ



Example of a temporary barrier that may be used across a sidewalk to close it or to separate pedestrians from work area. Including a top rail and base rail to be detectable.



Example where pedestrian detour is clearly marked, has detectable delineation, and temporary curb ramps.

Locations for Improvement within Project Area:

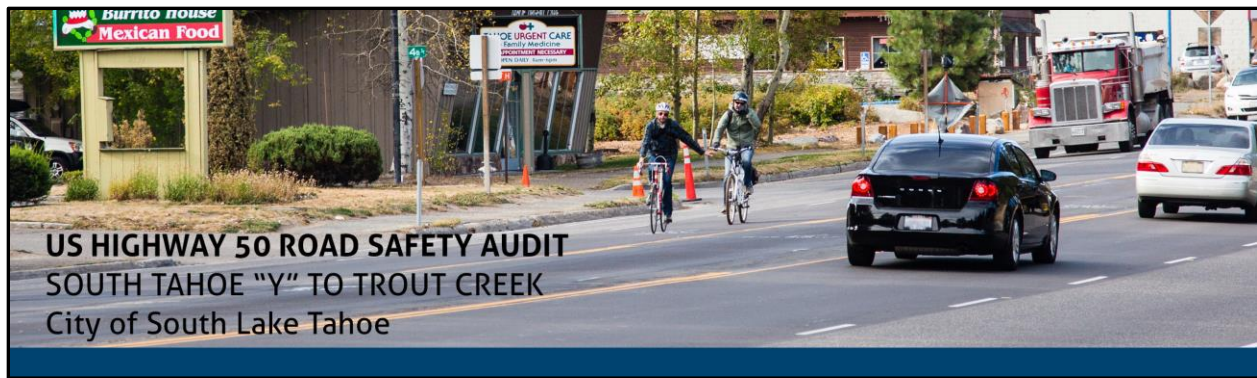
Contractor's submittals for Phases 2 and 3.

Implementation Next Steps:

1. **Update Contractor's Work Plan:** Caltrans should review the contractor's phasing of work and traffic control plan to assure they include an understandable, continuous, and accessible route for pedestrians and bicyclists through the work zone. Review should ensure that where pedestrians or bicyclists are crossing the street at unexpected locations, additional traffic control devices are used to alert drivers.

ⁱ FHWA, *Manual on Uniform Traffic Control Devices for Streets and Highways*, 2009, p. 550.

ⁱⁱ FHWA Course on Bicycle and Pedestrian Transportation, Lesson 12, "Pedestrian and Bicycle Facilities in Work Zones," 1999. https://safety.fhwa.dot.gov/PED_BIKE/univcourse/swtoc.cfm#toc



EDUCATION AND ENFORCEMENT

Issue Statement:



Providing context appropriate roadway and pathway design is a key factor in encouraging safe and lawful travel behaviors for all modes of transportation. Roadway design includes the width of the lanes, signing and pavement marking, lighting, roadside features, sidewalks, etc. Roadway design reduces conflict points between users, however, educating the traveling public about safe behavior and providing sufficient enforcement also plays a major role in the safety of our roadways. Although education efforts have recently increased over the last few years, under-reporting of crashes and ample enforcement is a well-known issue in the Lake Tahoe area. These

deficiencies are mostly due to limited staff, funding, and crash reporting technological database constraints. Some education programs have been performed at Lake Tahoe Unified School District schools through the TRPA Safe Routes to School Program which includes in-class bicycle and pedestrian safety modules and CHP led bicycle rodeos. Additional education is performed region-wide through the Lake Tahoe Bicycle Coalition (LTBC) *Bike Safe Lake Tahoe!* Campaign.

Unfortunately, safety issues attributed to behavior still remain for roadway users. Many bicycle riders think riding against traffic is safer when in fact it increases your chance of being a victim of a crash by 40 percent and is against the law per the California vehicle code. Numerous riders along U.S. Highway 50 were observed - during spot counts conducted by TRPA - riding the wrong way and very few of all bicycle riders (less than 1 in 10) were wearing a helmet.



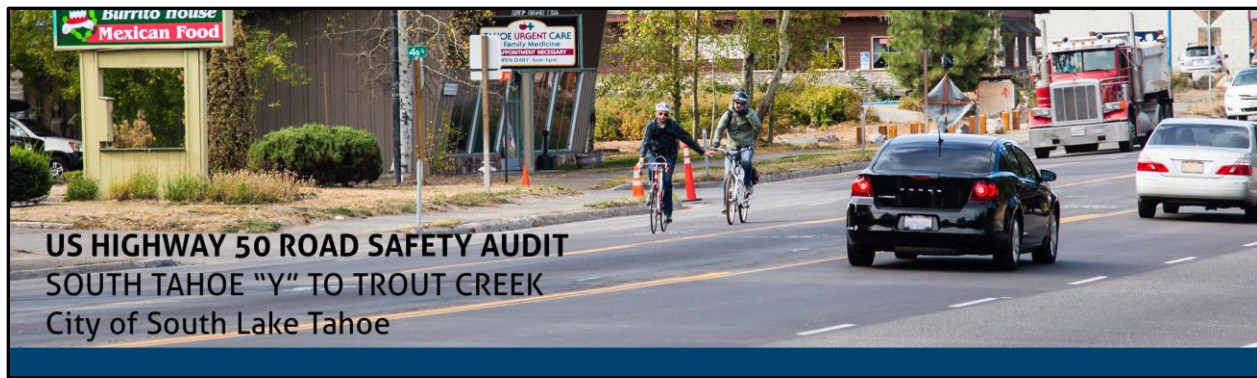
Noteworthy Practices:

Additional resources for education and enforcement are needed to reach more people on a more consistent basis and diverse strategies are desired for both year-round residents and visitors.

1. Education: Collaborate with agency, advocacy groups, employers, local lodging, and non-profit



partners to create safety campaigns that have a consistent message and broad reach. This could include radio Public Service Announcements (PSAs), social media, brochures, advertising at bus stops, signage, etc. This work can build off LTBC's *Bike Safe Lake Tahoe!* campaign. Other campaigns and strategies that could be considered are:



- Bike Helmet Use Campaign for local helmet law.
- Do NOT Ride Against Traffic Campaign (Bikes Always Go with the Flow).ⁱⁱ
- Three Feet for Safety Act Law local campaign.ⁱⁱⁱ
- Work with local drivers' education instructors to include best driver practices in relation to protecting bicyclist and pedestrian safety.
- Support local Safe Routes to School Programs.

- Enforcement:** Conduct warning or ticketing campaigns for wrong way bicycling, speeding in school zones, common yet illegal turning movements, and distracted driving to educate roadway users and deter continuation of unlawful behavior.

- Sting Operations:** Where police officers pose as common bicyclists and then pull over and warn and educate drivers for illegal behaviors towards bicyclists. The City of Chicago has an active and ongoing yearly Crosswalk Enforcement Initiative^{iv} that could be used as a model.
- Bike Patrol:** Use bike patrol officers on key bicycle routes and high-risk conflict areas.
- Data-Driven Approaches to Crime and Traffic Safety (DDACTS):** Consider the Department of Justice and National Highway Traffic Safety Administration's DDACTS program. DDACTS integrates location-based crime and traffic crash data to determine the most effective methods for deploying law enforcement and other resources. Drawing on the deterrent value of highly visible traffic enforcement and the knowledge that crimes often involve motor vehicles, the goal of DDACTS is to reduce crime, crashes, and traffic violations across the country.

Douglas County Sheriff's Office targets speeding this November

Staff Reports
October 26, 2017

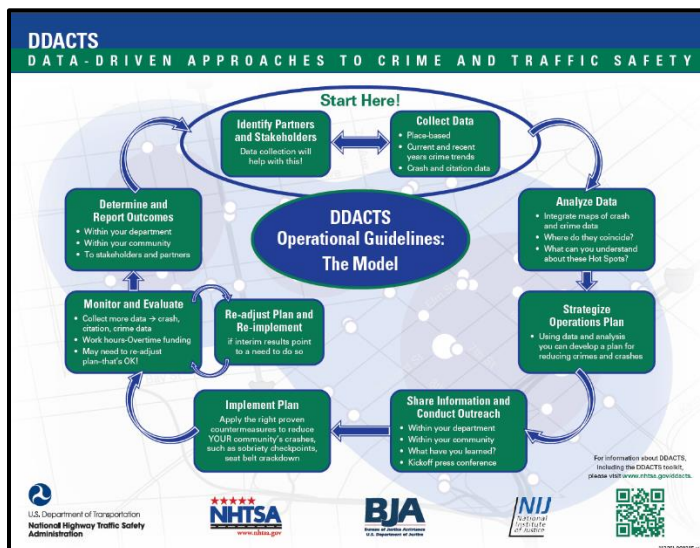
Share (0) Tweet Comments (0) Like (0)

Starting Nov. 1, law enforcement officials throughout Nevada will be focusing on speeding motorists in an effort to make the streets safer. The Douglas County Sheriff's Office, Nevada Highway Patrol and Lyon County Sheriff's Office will be joining forces to look for speeding drivers in Douglas and Lyon counties as part of the Joining Forces traffic safety program.

The Douglas County Sheriff's Office said in a press release that while many people do not think speeding to be dangerous while driving, it greatly increases the chances of being involved in a traffic accident. They also said there is a greater risk of losing control of a vehicle while speeding and the amount of time it takes to stop a vehicle increases when a driver is speeding.

The Joining Forces program is a multi-jurisdictional law enforcement program that encourages statewide enforcement in multiple areas such as speeding, distracted driving, pedestrian safety and seat belt use.

The Sheriff's Office encourages residents to wear a seat belt and remember to slow down.



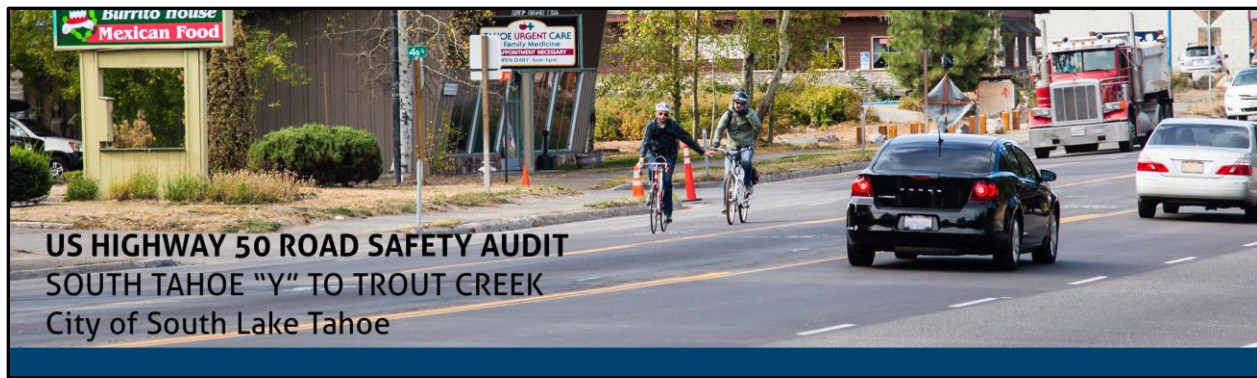
- Enforcement of Regulatory Signage and Use of Changeable Message Signs:** Either through sting operations or targeted enforcement, ensure that drivers are aware, educated, and follow signage that protects bicyclists. Consider including signage with stronger messages, such as the examples below.



R4-11



R117 (CA)



ⁱ City of Davis, <http://cityofdavis.org/city-hall/public-works/bike-pedestrian-program/learn-about-bike-laws-and-safety-tips>

ⁱⁱ City of Albuquerque, <https://www.cabq.gov/transit>

ⁱⁱⁱ California Bicycle Coalition, http://www.calbike.org/give_me_3

^{iv} City of Chicago,

http://www.cityofchicago.org/city/en/depts/cdot/provdrs/ped/svcs/crosswalk_enforcementinitiatives.html

^v TRPA,

[http://tahoempo.org/OnOurWay/projects/SRTS/Final LTUSD%20SRTS%20Master%20Plan_Combined.pdf](http://tahoempo.org/OnOurWay/projects/SRTS/Final_LTUSD%20SRTS%20Master%20Plan_Combined.pdf)

^{vi} LTBC, <http://www.tahoebike.org/where-to-ride/bike-safety/>

^{vii} FHWA, http://safety.fhwa.dot.gov/local_rural/pedcampaign/radiopsa.htm, and

http://safety.fhwa.dot.gov/local_rural/pedcampaign/tvpsa.htm

^{viii} ATP, <http://www.dot.ca.gov/hq/LocalPrograms/atp/>

^{ix} OTS, <http://www.ots.ca.gov/Grants/>

^x People for Bikes, <http://peopleforbikes.org/our-work/community-grants/>

^{xi} SB 1, <http://www.rebuildingca.ca.gov/>

^{xii} SRTS, <http://www.dot.ca.gov/hq/LocalPrograms/saferoutes/saferoutes.htm>